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Timber,
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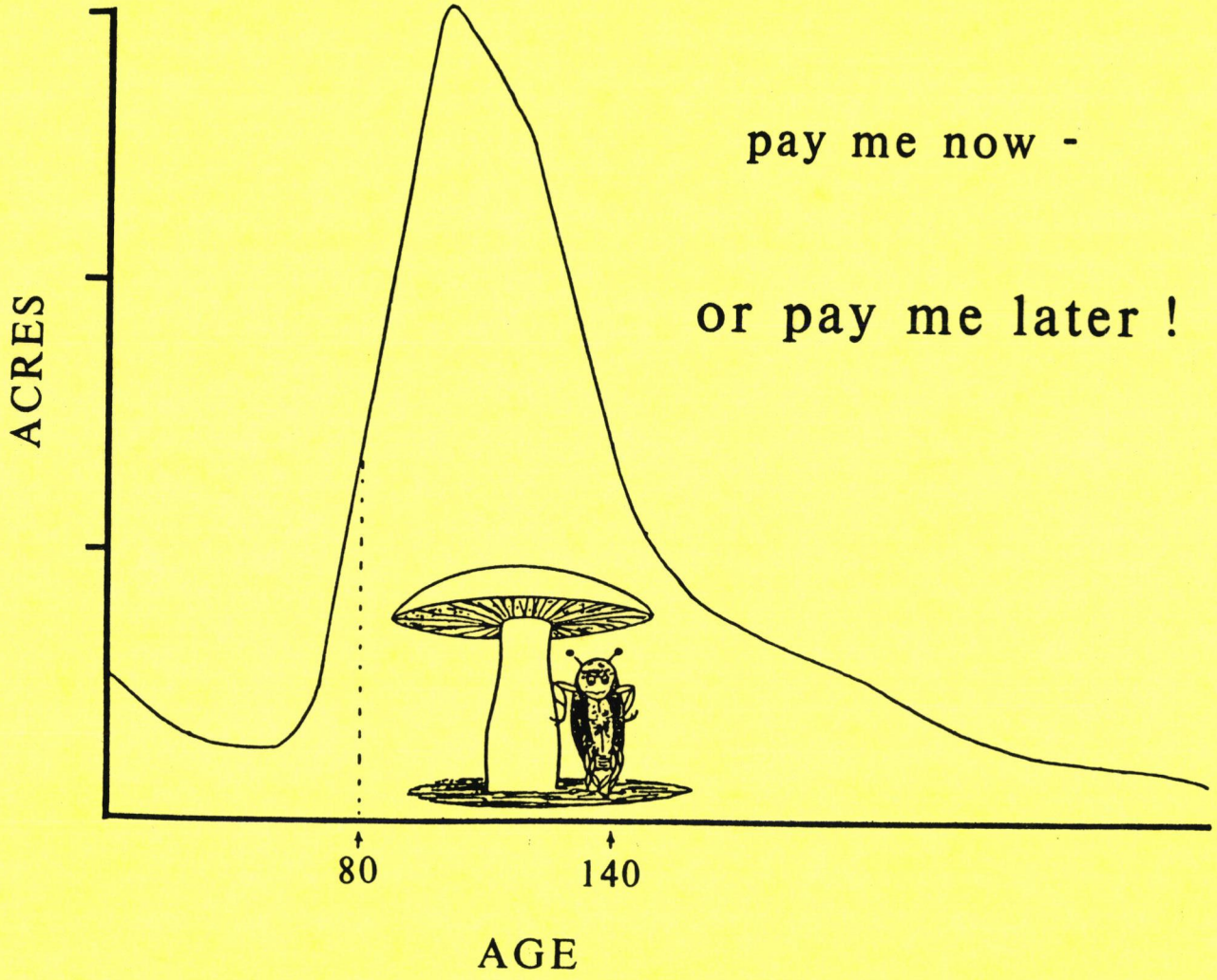
Forestry
Management

Forest Service
Denver, Colorado

Forest Pest Conditions in the Rocky Mountain Region for 1986

REVISED



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FOREST PEST CONDITIONS

IN THE

ROCKY MOUNTAIN REGION

1986

By

Gene Lessard, Entomologist
Diane Hildebrand, Plant Pathologist
and
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July 1987

Timber, Forest Pest and
Cooperative Forestry Management
Rocky Mountain Region
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ACKNOWLEDGEMENTS

The Forest Pest Management (FPM) staff of the Timber, Forest Pest, and Cooperative Forestry Management Unit extends appreciation to all cooperators who contributed information to this report.

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INTRODUCTION

Forest Pest Management is responsible for detection, evaluation, prevention, and suppression of insects and diseases on forested Federal lands. Forest Pest Management also administers financial and technical assistance programs, which are available to State and private landowners of forested lands through the Cooperative Forestry Assistance Act of 1978 Public Law (95-313).

FOREST PEST MANAGEMENT WORKSHOPS AND TRAINING

The Forest Pest Management staff group, primarily Ken Lister and Michael Sharon, conducted workshops on recognition and suppression of major forest diseases and insects in the Region. Training consisted of two-day workshops each, held in Monte Vista, Colorado (June 4-5) and Steamboat Springs, Colorado (June 18-19). Sessions were attended by resource managers from the Colorado State Forest Service, the U.S. Air Force Academy, the Bureau of Land Management, the National Park Service, and the USDA Forest Service. A total of 59 people were trained at these sessions in 1986.

On November 16, 1986, Diane Hildebrand presented a Dwarf Mistletoe Seminar for the Colorado Forestry Association in the Black Forest, northeast of Colorado Springs. Chuck Kostecka from the Colorado State Forest Service, Woodland Park Office, also participated and provided valuable input. Twenty eight people attended, including a few private forestry consultants. Private landowners came from as far south as Colorado Springs and from as far north as Loveland. The seminar lasted 3 hours and included good audience participation.

DISEASE AND INSECT CONDITIONS IN BRIEF

Lodgepole pine dwarf mistletoe and comandra blister rust continued as the most damaging disease agents in the Rocky Mountain Region. Survey and suppression activities for lodgepole pine dwarf mistletoe have been continued in Colorado and Wyoming.

Root diseases are being monitored throughout the Region. Although annual losses are not known, it is suspected that they cause a considerable drain on the resources in the form of growth loss and mortality. Armillaria root disease and mountain pine beetle have been shown to be significantly associated in ponderosa pine stands in the Black Hills of South Dakota.

The western spruce budworm and mountain pine beetle still rank as the most notable extensively damaging insects in the Region. Permanent plots continue to be monitored to assess budworm impact on annual growth and mortality to Douglas-fir.

Concern is growing about gypsy moth infestations in several communities along the Colorado Front Range.

The use of pesticides continues as an important part of integrated pest management. Pesticides are valuable tools in forest tree nursery management and control of noxious weeds and undesirable vegetation in range management. The Nationwide ban on aerial application of herbicides continued in 1986.

The major cover types in Region 2 have age class distributions which are not conducive to a healthy forest. In all cases the majority of the trees in a cover type are approaching maturity. Insects and diseases are expected to be a driving force, along with fire, in modifying the current vegetation.

DOUGLAS-FIR COVER TYPE

Figure 1 displays the percent of area by age class for the Douglas-fir cover type in Region 2 (from the Resource Inventory System database). Of the estimated 1.1 million acres of cover type of National Forest lands, 80 percent of the acres are between 81 and 180 years of age. There are an estimated additional 2.0 million acres of Douglas-fir cover type on other Federal, State, and private lands in the Region.

On average, only 1.3 percent of the acres have been regenerated per decade over the past 80 years. In the northern and central Rockies, diameter and height growth are negligible beyond 200 years of age. Nearly 5 percent of the cover type is beyond 200 years of age. Rocky Mountain Douglas-fir rarely lives beyond 400 years of age. The average annual volume harvested in the Region is about 3.4 million board feet (about 1.5 percent of the total Regional volume).

INSECTS AND DISEASES THAT AFFECT THE DOUGLAS-FIR COVER TYPE

Western spruce budworm: *Choristoneura occidentalis* Freeman

Aerial reconnaissance surveys for budworm date back to 1960. From 1960 to 1963, acres infested averaged 579,000 $\pm$ 33,000. Infestations declined in 1963 and remained relatively low through 1975 (98,000 $\pm$ 10,800 acres) (Figure 2). In 1976, acres infested increased nearly six-fold. In general infestations continued to increase to a high of 2.7 million acres in 1983. Infestations declined more than two-fold by 1986 to 1.1 million acres. However, this level of infestation is still more than 10 times the level of infestation in the mid to late 60's and early 70's. From 1976 to 1986, the average acres infested per year is estimated at 1.5 $\pm$ 0.2 million. Egg mass surveys were not conducted in 1986, so information on population trend for 1987 is not available.

A breakdown of acres infested by State and land ownership for 1986 is displayed in Table 1. The majority of the infestation occurred on Forest Service (63%) and Private (27%) lands in Colorado.

With the Douglas-fir cover type comprised primarily of old, uneven-aged stands, western spruce budworm is expected to be a continuing problem throughout the Region in the future.

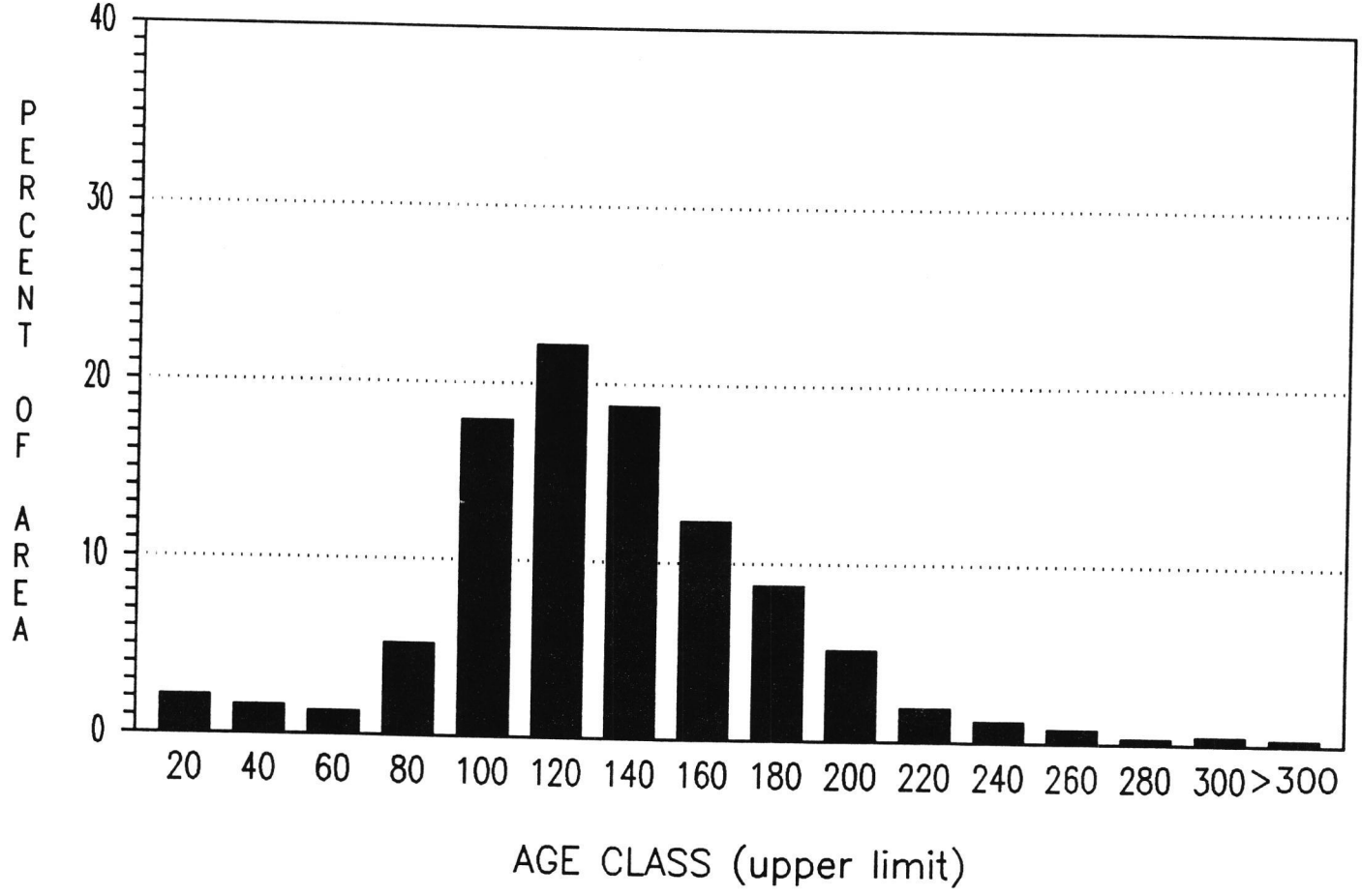

Figure 1: Percent of Douglas-fir covertype by age class in Region 2.

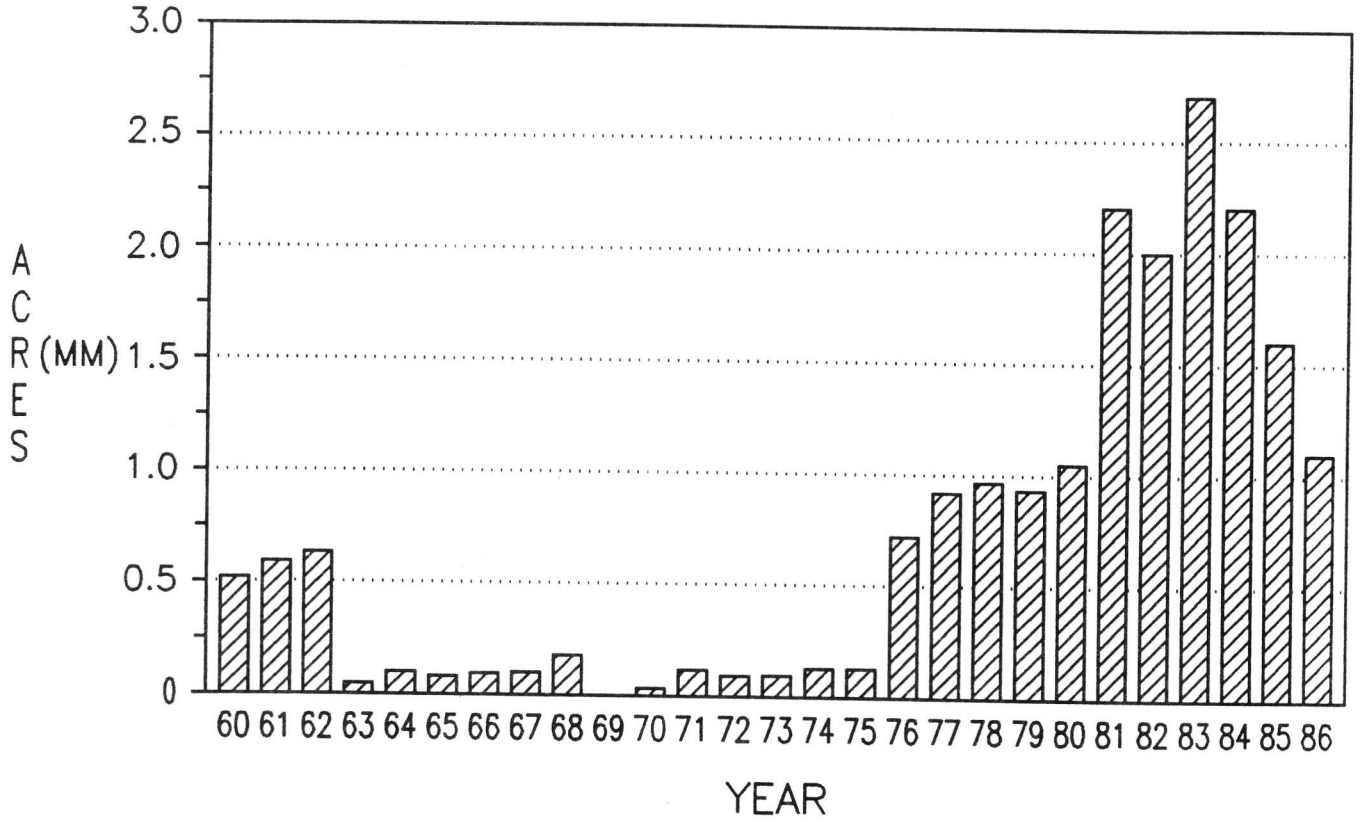

Figure 2: Western spruce budworm defoliation in Region 2, from 1960 to 1986.

TABLE 1. ACRES OF WESTERN SPRUCE BUDWORM-CAUSED DEFOLIATION FROM AERIAL AND GROUND SURVEYS, 1986.

	NATIONAL FORESTS	OTHER FEDERAL	STATE	PRIVATE	TOTAL
Colorado	698,000	79,000	1,000	302,000	1,080,000
Wyoming	14,000	3,000	-	3,000	20,000
TOTAL	712,000	82,000	1,000	305,000	1,100,000

Douglas-fir beetle: Dendroctonus pseudotsugae Hopkins

Acres of Douglas-fir beetle-caused tree mortality are displayed in Table 2. The majority of the infestation occurred on Forest Service (73%) and private (22%) lands in Colorado.

Normally, Douglas-fir beetle populations are maintained in trees weakened by root rot, old age, lightning, etc. However, with continued stress caused by western spruce budworm defoliation, populations are shifting to budworm infested trees. This shift can be expected to continue as long as budworm populations remain at epidemic levels. Much of this mortality is occurring on steep or inaccessible lands.

TABLE 2. ACRES OF DOUGLAS-FIR BEETLE-CAUSED MORTALITY, 1986.

	NATIONAL FORESTS	OTHER FEDERAL	STATE	PRIVATE	TOTAL
Colorado	14,770	650	160	3,360	20,040
Wyoming	170	-	-	-	170
TOTAL	14,940	650	160	4,460	20,210

Douglas-fir tussock moth: Orgyia pseudotsugata McDunnough.

In 1985 and 1986, Douglas-fir tussock moth populations were detected by use of pheromone traps on the Pike National Forest. Population levels were endemic: 0.52 and 0.95 adults per plot in 1985 and 1986, respectively. An average of 25 adults per plot is required to produce visible defoliation.

In 1987, 150 permanent plots will be established on the Pike National Forest to monitor tussock moth populations and assess population behavior over time.

Douglas-fir dwarf mistletoe: Arceuthobium douglasii Engelm.

Dwarf mistletoe occurs on Douglas-fir in the southern two thirds of Colorado. Presuppression survey and suppression projects are being funded by FPM on 2,300 acres on the Rio Grande National Forest.

PONDEROSA PINE COVER TYPE

Figure 3 displays the percent of area by age class for the ponderosa pine cover type in Region 2. Of the estimated 1.9 million acres of cover type on National Forest lands, 78 percent of the acres are between 61 and 140 years of age. There are an estimated additional 800 thousand acres of ponderosa pine cover type on other Federal, State and private lands in the Region.

On average, only 4.0 percent of the acres have been regenerated per decade over the past 80 years. Ponderosa pine can live to 600 years of age but are generally considered to be mature at about 150 to 225 years and over-mature beyond 225 years. About 10 percent of the ponderosa pine cover type in the Region is mature or over-mature. The average annual volume harvested in the Region is about 106 million board feet (about 46.5% of the total Regional volume).

LODGEPOLE PINE COVER TYPE

Figure 4 displays the percent of area by age class for the lodgepole pine cover type in Region 2. Of the estimated 2.3 million acres of cover type on National Forest lands, 80 percent of the acres are between 80 and 180 years of age. There are an estimated 1.0 million acres of lodgepole pine cover type on other Federal, State and private lands in the Region.

On average, only 2.5 percent of the acres have been regenerated per decade over the past 80 years. Stands at lower elevations start deteriorating at 80 to 100 years, but can reach 600 years under ideal conditions. About 80 percent of the lodgepole pine cover type in the Region is in excess of 80 years of age. Average annual volume harvested in the Region is about 46 million board feet (about 20.0% of the total Regional volume).

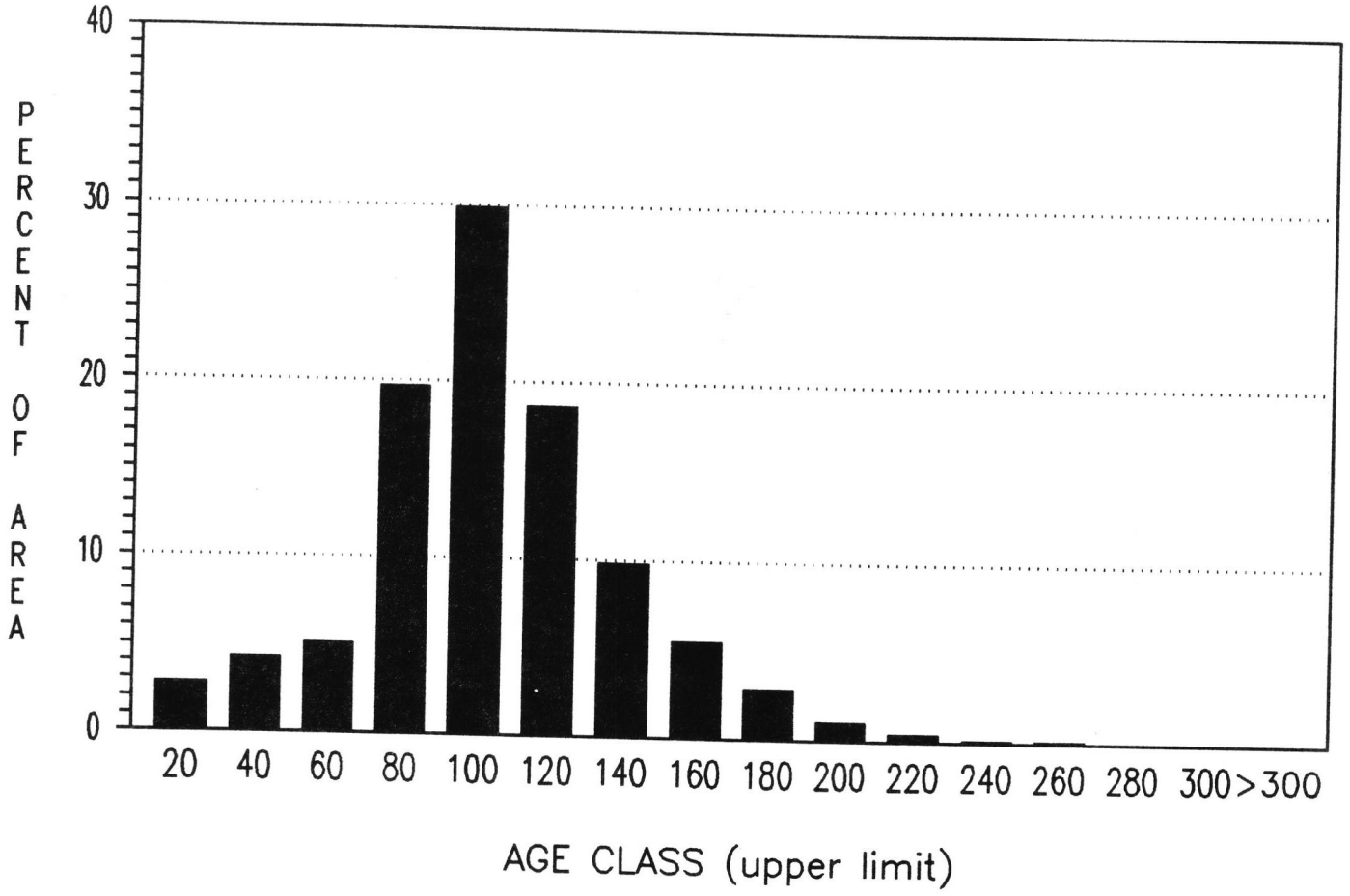

Figure 3: Percent of ponderosa pine covertype by age class in Region 2.

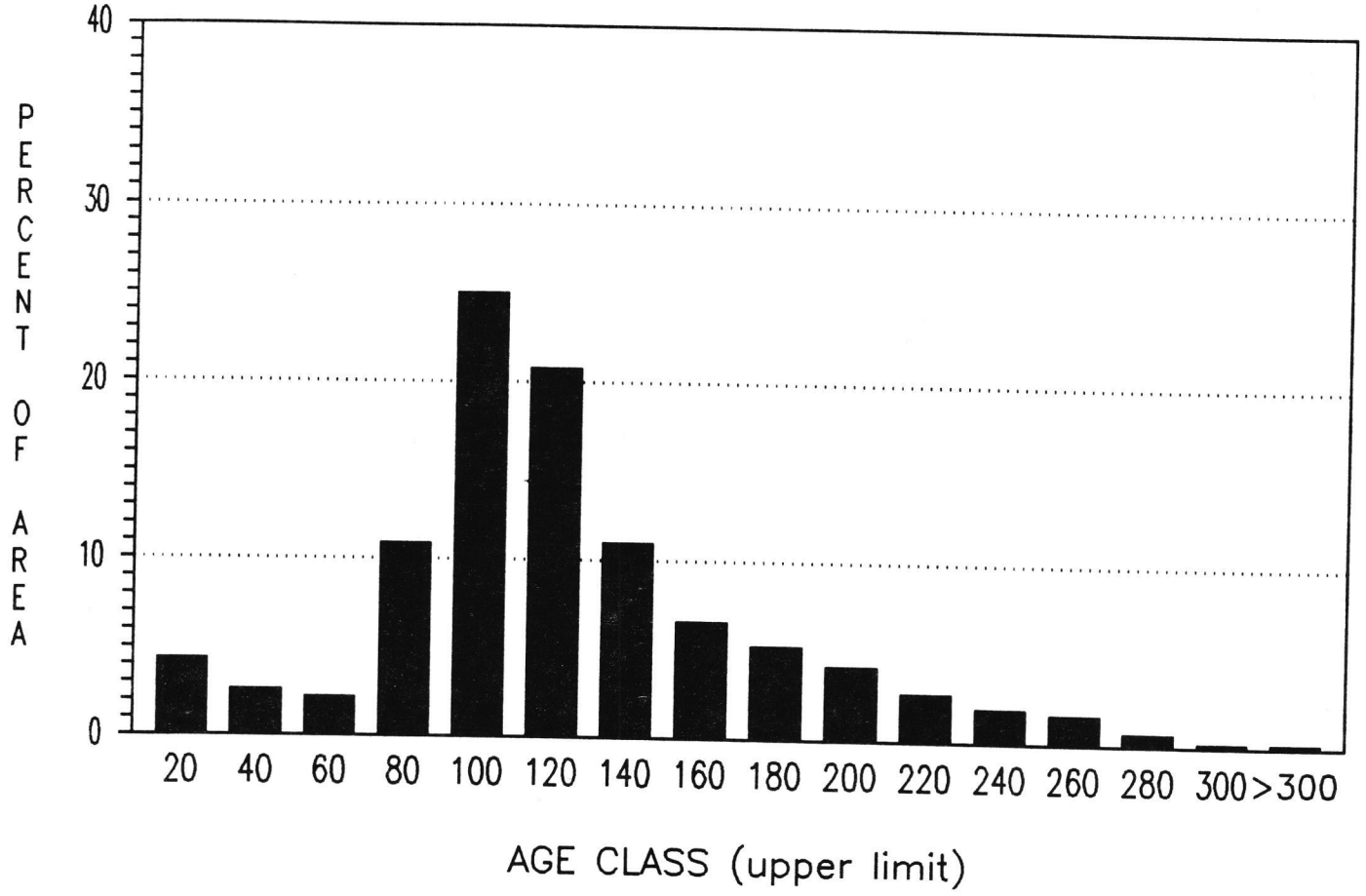

Figure 4: Percent of lodgepole pine covertype by age class in Region 2.

INSECTS AND DISEASES THAT AFFECT THE LODGEPOLE AND PONDEROSA PINE COVER TYPES

Mountain Pine Beetle: Dendroctonus ponderosae Hopk.

Mountain pine beetle populations have declined Region-wide for the second year in a row. This decline began with a high level of larval mortality in the winter of 1984-85. In lodgepole pine, an estimated 83,180 trees were infested over 98,530 acres (0.8 trees per acre) in 1986. In ponderosa pine, an estimated 48,150 trees were infested over 22,080 acres (2.2 trees per acre) in 1986.

Table 3 displays acres and trees infested in 1985 by State, forest type, and land ownership or administration. The majority of the infestation (77 percent) occurred on Federally administered lands with 64 percent in lodgepole pine and 13 percent in ponderosa pine. The remaining 23 percent occurred on State and private lands with 17 percent in lodgepole pine and 5 percent in ponderosa pine.

Table 4 displays acres and trees infested in 1986. This table reflects a 40 percent "across-the-board" decline in populations from 1985 to 1986. Of the nearly 100,000 acres of lodgepole pine infested, the average number of infested trees per acre is 0.8. Since the decline of mountain pine beetle was caused primarily by adverse weather, populations are expected to return to high levels in the next few years. Populations in ponderosa pine (2.2 infested trees/acre) on slightly over 22,000 acres are at more than twice the level of those in lodgepole pine and beginning to show signs of recovery primarily in the Black Hills.

Figure 5 displays the long-term infestation trend in ponderosa pine in the Black Hills of South Dakota and Wyoming. Populations began to increase in 1968, peaked in 1974, and declined to low levels by 1984. An estimated 250 MMBF of ponderosa pine were lost to the beetle during this period. Ground surveys in the Black Hills indicated that populations reached a low of 0.3 trees per acre in 1984 and fluctuated at low levels in 1985 and 1986. The current biological evaluation predicts beetle populations will begin to increase in 1987 or 1988, peak by 1999, and decline by 2006 with an estimated loss for the period of about 500 MMBF.

Roundheaded Pine Beetle: Dendroctonus adjunctus Blandford

Roundheaded pine beetle occurs with mountain pine beetle on the Uncompahgre Plateau. Ground surveys conducted in 1986 and 1985 reveal there were a total of 6 trees per acre each year infested with either species.. Roundheaded pine beetle increased in 1986 to 5 trees per acre from 3 trees per acre in 1985; mountain pine beetle decreased to 1 tree per acre in 1986 from 3 trees per acre in 1985.

Western Pine Beetle: Dendroctonus brevicomis LeConte

Western Pine Beetle remains low. A few scattered single infested trees occur on the Uncompahgre Plateau and the lower Doloris River drainage on the San Juan National Forest.

TABLE 3. ACRES AND TREES INFESTED WITH MOUNTAIN PINE BEETLE IN 1985 (FROM 1986 AERIAL DETECTION SURVEYS).

	NATIONAL FORESTS		OTHER FEDERAL		STATE		PRIVATE		TOTAL	
	Acres	Trees	Acres	Trees	Acres	Trees	Acres	Trees	Acres	Trees
COLORADO										
Lodgepole	86,860	76,860	28,230	13,080	2,370	640	29,970	17,280	147,430	107,860
Ponderosa	8,640	20,390	240	1,000	10	30	3,180	15,910	12,070	37,330
WYOMING										
Lodgepole	12,330	22,110	2,230	4,550	-	-	2,220	4,130	16,780	30,790
Ponderosa										
SOUTH DAKOTA										
Ponderosa	4,100	8,960	120	270	20	110	400	900	4,640	10,240
TOTAL	122,840	147,170	32,920	23,120	3,730	2,120	41,520	46,480	201,010	218,890

TABLE 4. ESTIMATED ACRES AND TREES INFESTED WITH MOUNTAIN PINE BEETLE IN 1986 (FROM 1986 GROUND SURVEYS).

	NATIONAL FORESTS		OTHER FEDERAL		STATE		PRIVATE		TOTAL	
	Acres	Trees	Acres	Trees	Acres	Trees	Acres	Trees	Acres	Trees
COLORADO										
Lodgepole	52,120	46,110	16,940	7,850	1,420	380	17,980	10,370	88,460	64,710
Ponderosa	5,180	12,240	140	600	10	20	1,910	9,550	7,240	22,410
WYOMING										
Lodgepole	7,400	13,260	1,340	2,730	-	-	1,330	2,480	10,070	18,470
Ponderosa	6,550	11,310	1,260	2,530	800	800	3,450	4,960	12,060	19,600
SOUTH DAKOTA										
Ponderosa	2,460	5,380	70	160	10	60	240	540	2,780	6,140
TOTAL	73,710	88,300	19,750	13,870	2,240	1,260	24,910	27,900	120,610	131,330

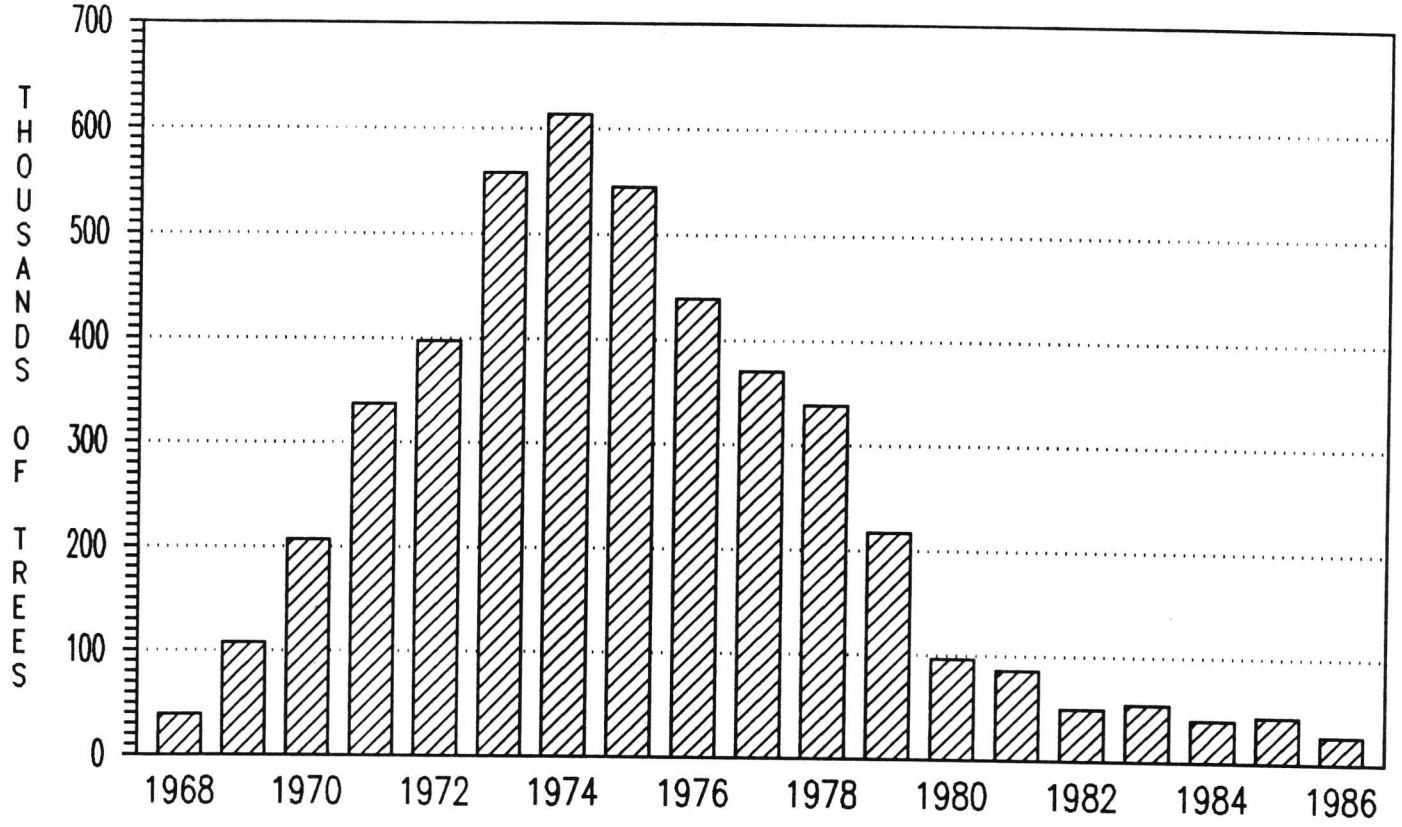

Figure 5: Estimated number of trees killed by mountain pine beetle, in the Black Hills National Forest from 1968 to 1986.

IPS ENGRAVER BEETLES: Ips spp.

Ips beetle populations which began to reach outbreak levels in 1984 in the Black Hills have declined to low levels in 1986.

HIGH COUNTRY PROJECT

The High Country Integrated Pest Management Project (HCP) began in Summit and upper Eagle Counties (originally SUE) in 1981. The project was expanded to include all of Eagle and Grand Counties in 1983. The goals of this project are to:

1. Minimize adverse impacts of Mountain Pine Beetle, by establishing insect and disease resistant forests.
2. Maintain, or improve, scenic and recreation qualities.
3. Maintain, or improve, wildlife habitats.
4. Reduce wildfire hazards.
5. Salvage infested and dead lodgepole pine.

Figure 6 A, B, and C display the number of infested lodgepole pine trees within each county in the project from 1979 to 1986. The 1986 estimate is based on a 0.6x attack ratio from 1985 to 1986. Data for all other years are from annual aerial reconnaissance surveys.

Figure 7 displays the number of infested lodgepole pine trees within the Priority A Treatment Area in the Dillon Basin from 1979 to 1986.

CASPER MOUNTAIN PROJECT

Landowner concern about mountain pine beetle activity on Casper Mountain (Wyoming) and public meetings resulted in the formation of the Casper Mountain Pine Beetle Association (CMPBA) in the fall of 1980. The CMPBA coordinates activities among landowners and city, State, and Federal agencies. Increased requests for assistance led to increased State appropriations for forest management. Initially, efforts focused on the central residential portion of Casper Mountain, with the State supplementing the thinning and harvesting by landowners with cutting and burning on steep slopes. Recently, project work has expanded to Muddy Mountain to the south. By the summer of 1985, over 2,800 cords of wood were being harvested from private and State lands. Infestation levels are indicated in figure 8. Steep, inaccessible areas remain a challenge to both the landowners and forest managers. The Bitterroot cable logging system was successfully used on Casper Mountain in the fall of 1986. Use of the Clearwater Yarder is scheduled for 1987. There are portions of Casper Mountain not accessible for tree removal even with these techniques.

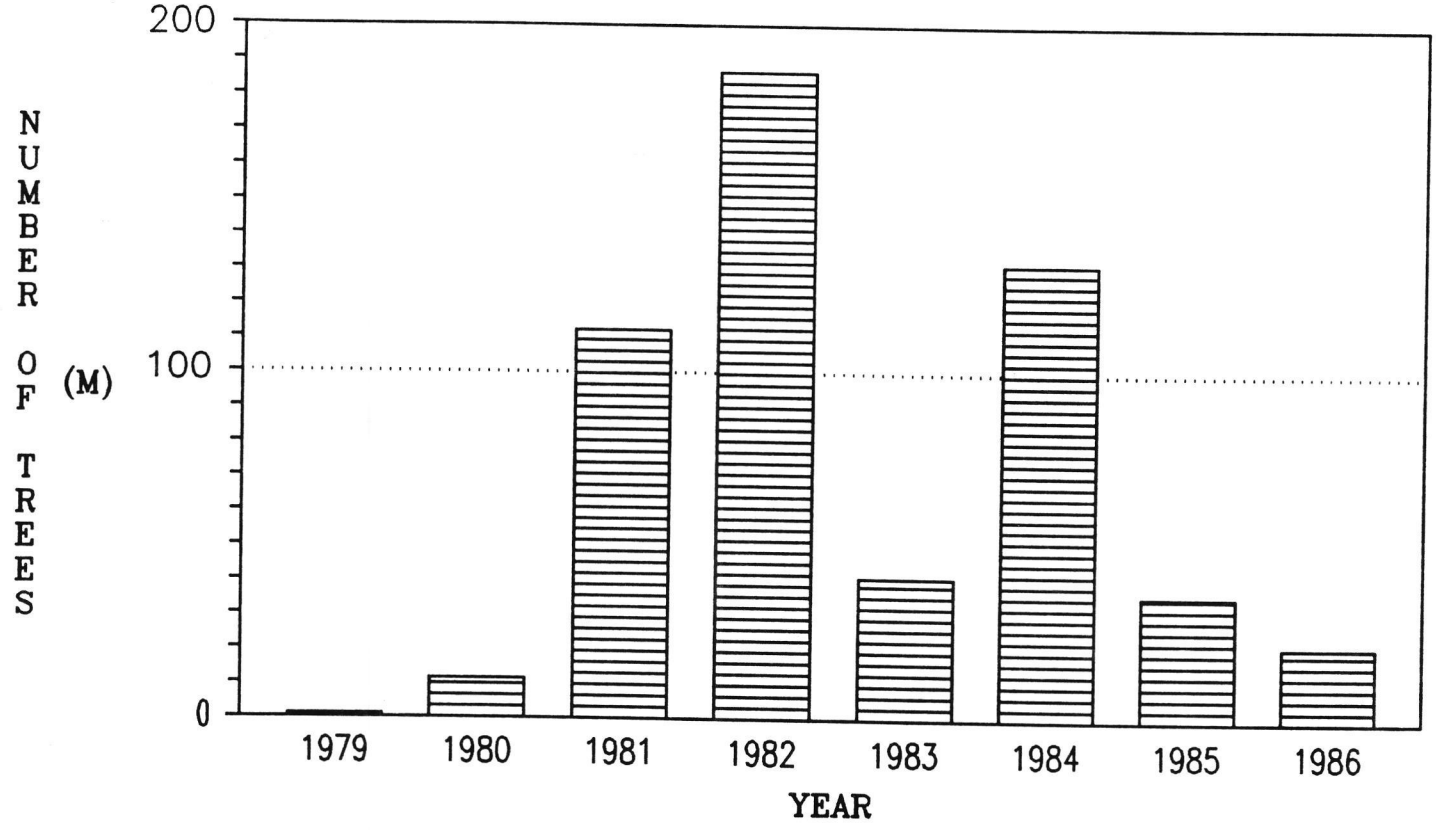

Figure 6A: Number of trees killed by mountain pine beetle in Summit County, Colorado; 1979–1986.

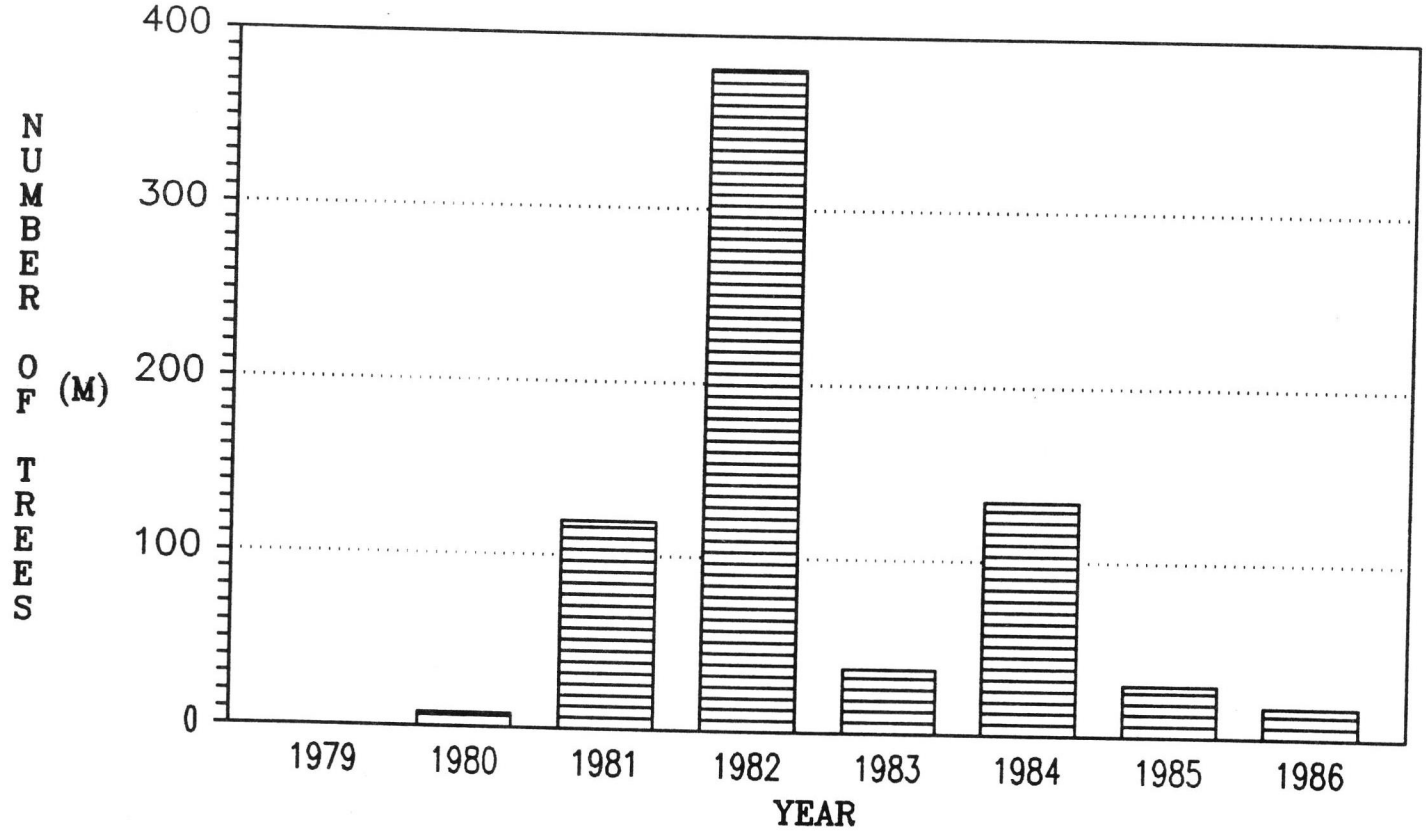

Figure 6B: Number of trees killed by mountain pine beetle in Eagle County, Colorado; 1979–1986.

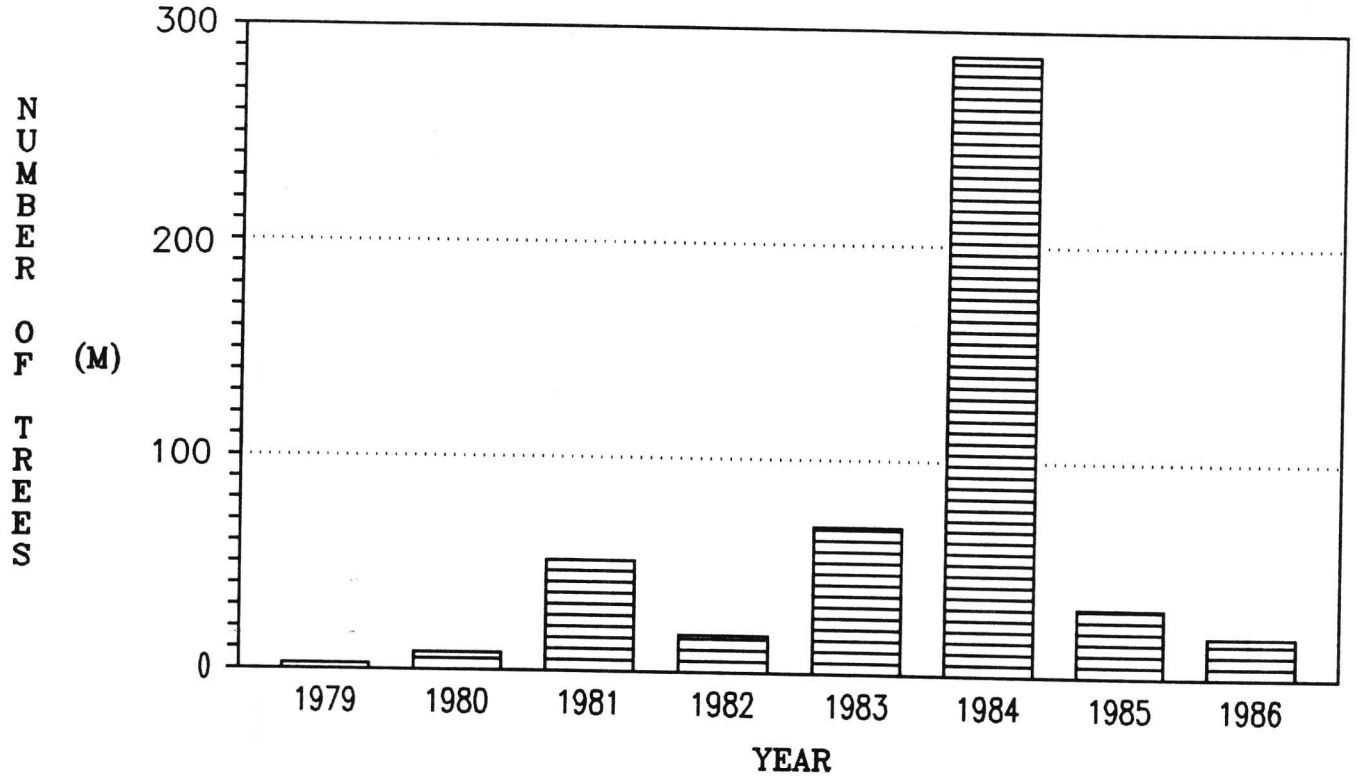

Figure 6C: Number of trees killed by mountain pine beetle in Grand County, Colorado; 1979–1986.

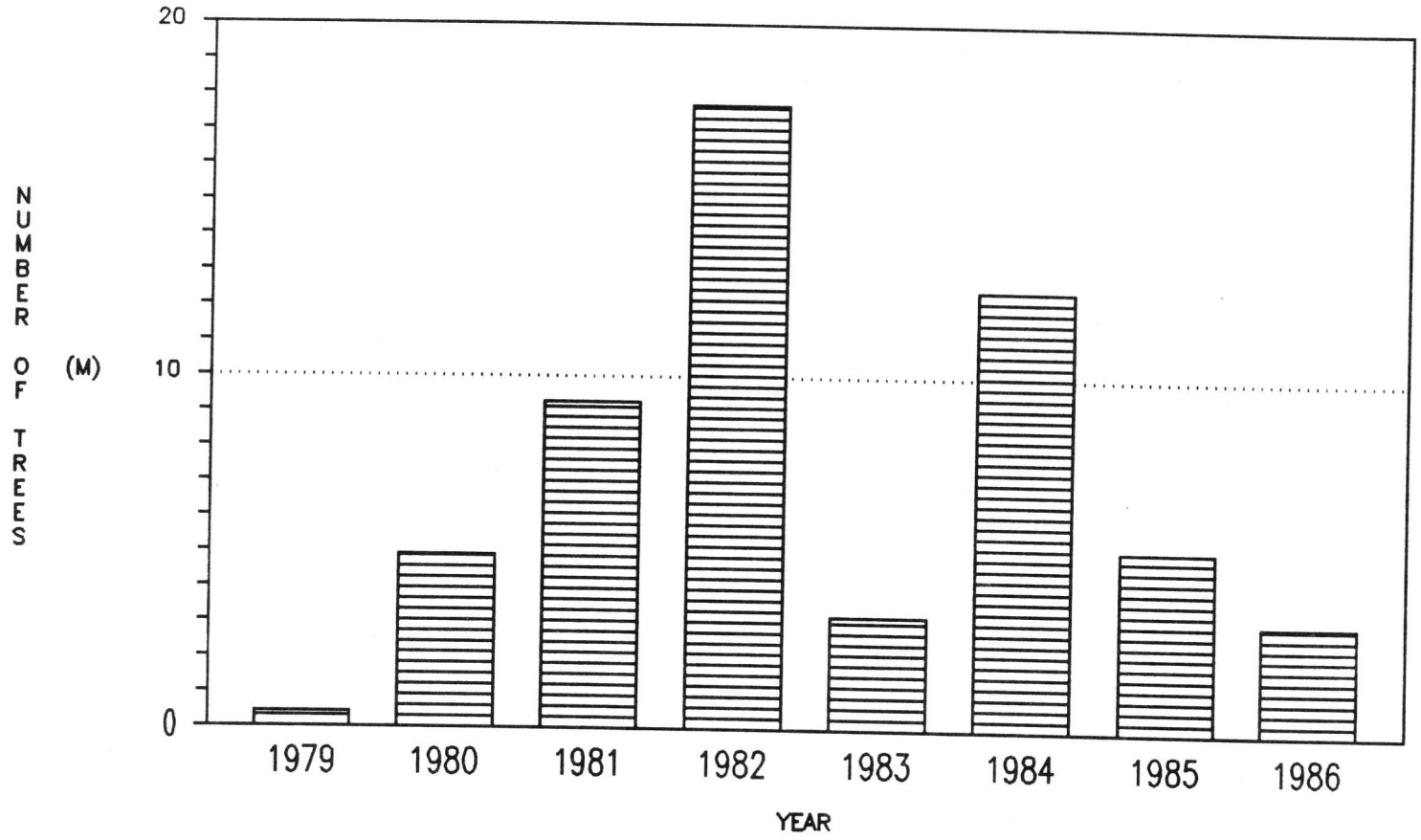

Figure 7: Number of trees killed by mountain pine beetle in the High Country Project Priority Area, Colorado; 1979–1986.

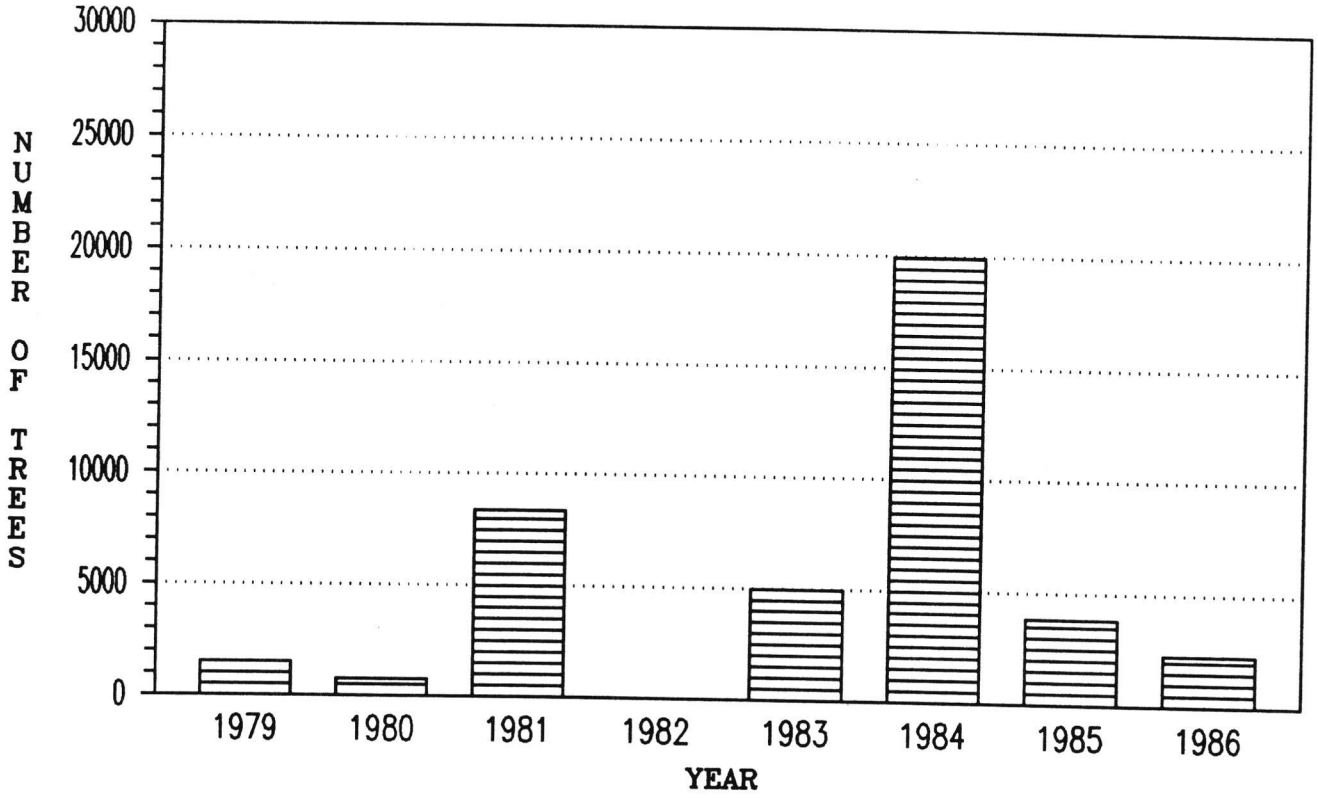

Figure 8: Number of trees killed by mountain pine beetle on Casper and Muddy mountains, Wyoming; 1979–1986.

No data available for 1982.

ROOT DISEASES: Armillaria sp. and Fomes annosus (Fr.) Cke.

At endemic levels, mountain pine beetle tends to select Armillaria infected trees. These trees then become the focal point for epidemic populations. This association between bark beetles and root disease has been noted especially in the Black Hills.

Although annual losses to root diseases are not known, it is suspected that they cause a considerable drain on the timber resource in the form of growth loss and mortality. Armillaria and annosus root diseases cause the most mortality in thinned and cut stands where old infected roots and stumps remain as sources of inoculum.

COMANDRA BLISTER RUST: Cronartium comandrae Pk.

Comandra blister rust continues to be the most serious disease of lodgepole pine on the Wind River Ranger District, Shoshone National Forest. More than half of the mature trees are infected and 85 percent of the infected trees have dead tops. The forest is incorporating the results of recently completed research on growth loss projections into management of infested stands.

DWARF MISTLETOES: Arceuthobium spp.

Approximately 20 percent of the ponderosa pine type is infested with dwarf mistletoe, A. vaginatum (Willd.) Presl. subsp. cryptopodum (Engelm.) Gill. Annual losses amount to over 885,000 cubic feet. Presuppression survey and suppression projects are being funded by FPM on 17,120 acres of mixed ponderosa pine and lodgepole pine on the Pike and San Isabel National Forests.

Lower montane and foothills ponderosa pine in Colorado is heavily infested with dwarf mistletoe. These forested acres are mostly privately owned.

Action plans for survey and suppression of lodgepole pine dwarf mistletoe, A. americanum Nutt. ex Engelm., have continued throughout the Region. Presuppression surveys were conducted on 23,000 acres on the Pike and San Isabel, Rio Grande, and Routt National Forests. Cultural control was conducted on 2,410 acres on the Arapaho and Roosevelt; Grand Mesa; Uncompahgre and Gunnison; Medicine Bow; Pike and San Isabel; Rio Grande; Routt; Shoshone and White River National Forests (Table 5).

TABLE 5. ACRES OF PRESUPPRESSION SURVEYS AND SUPPRESSION PROJECTS FUNDED BY FPM AND CONDUCTED IN 1986 FOR DWARF MISTLETOE ON FEDERAL LANDS, MOSTLY IN LODGEPOLE PINE TYPE.

National Forest	Presuppression Survey Acres	Suppression Project Acres
Pike & San Isabel *	17,000	120
Arapaho & Roosevelt	--	500
Grand Mesa, Uncompahgre & Gunnison	--	500
Medicine Bow	--	500
Rio Grande **	2,000	300
Routt	4,000	300
Shoshone	--	100
White River	--	90
TOTALS	23,000	2,410
Bureau of Land Management (USDI)		
Colorado	1,040	353
Wyoming	10,000	145
TOTALS	11,040	478

* Mixed between lodgepole pine dwarf mistletoe and ponderosa pine dwarf mistletoe.

** Primarily Arceuthobium douglasii on Douglas-fir.

Control of dwarf mistletoe with Ethephon

A cooperative research project with the North Central Forest Experiment Station, Rocky Mountain Forest and Range Experiment Station, Arapaho and Roosevelt National Forests, and TFP&CFM (R-2) to evaluate the potential use of Ethephon, an ethylene-releasing agent, looks promising.

Dwarf mistletoe shoot abscission rates of 74-100% on individual infections of Arceuthobium americanum on lodgepole pine was consistently achieved with August applications of 2500 ppm Ethephon plus surfactant using three methods of application (hand held bottle sprayer, backpack mist blower, and truck mounted hydraulic hand-jet sprayer). Most shoots abscised from infections within 2 to 5 weeks after treatment. Ethephon did not kill the parasite's endophytic system in the host tissue. Therefore, new shoots began developing on some infections 1 to 2 years after treatment. Based on the lengthy life cycles of this species of dwarf mistletoe, it is predicted that Ethephon control can temporarily prevent or reduce spread of infection for up to 4 years and possibly provide some degree of control even longer. Ethephon has potential use, especially in high value stands, recreation areas, seed orchards, and ornamental plantings around homes, cabins and business establishments.

An attempt was made to obtain similar control with aerial applications. On August 21, 1986, Ethephon was applied via helicopter at rates of 1200 and 2400 ppm/10 gal. water/acre plus surfactants to lodgepole pine infected with dwarf mistletoe. Evaluations 5 weeks after treatment showed that neither rate caused abscission of dwarf mistletoe shoots, possibly because the volume used was insufficient to obtain adequate contact of Ethephon with individual mistletoe shoots.

Additional studies are needed to evaluate the long-term effects of Ethephon treatments on dwarf mistletoes, their hosts, and surrounding vegetation. Additional evaluations under forest conditions are planned in 1987.

North Park Dwarf Mistletoe Study

In North Park, Colorado, a cooperative (RMFRES and RM Region) study of silvicultural treatments for dwarf mistletoe infected lodgepole pine was continued. A 21-year examination was made of the 37 one-half acre plots established in 1965. The stands are in three age classes, now about 40, 50 and 60 years old. Results are being analyzed and will be presented in a RM Research Paper.

NEEDLECASTS: Lophodermella concolor (Dearn.) Darker

Lodgepole pine needlecasts, caused by various fungi including Lophodermella concolor (Dearn.) Darker and L. montivaga Petrak, were widespread along the Colorado Front Range and on the Routt, Arapho, and San Isabel National Forests. This is the second year that needlecasts have been observed, probably as a result of weather conditions favorable for infection.

ASPEN COVER TYPE

Figure 9 displays the percent of area by age class for the aspen cover type in Region 2. Of the 1.5 million acres of cover type on National Forest lands, 78 percent are between 61 and 120 years of age. There are an estimated additional 1.1 million acres of cover type on other Federal, State, and private lands in the Region.

On average, only 6.0 percent of the acres have been regenerated per decade over the past 80 years. Pathological rotation is usually considered to be 80 to 90 years of age. About 52 percent of the cover type is beyond 80 years. With more than half of the cover type beyond pathological rotation, insects and diseases are expected to perform a primary role in aspen stand deterioration. If the current extent of the aspen cover type is to be maintained, then 12.5 percent of the acres (330,000) need to be regenerated per decade. Under current management levels, the acres of aspen cover type are expected to decline by 6 to 7 percent per decade. These acres will probably succeed to more tolerant species, such as spruce and fir. The average annual volume harvested in the Region is about 6.9 million board feet (about 3.0% of the total Regional volume).

INSECTS AND DISEASES THAT AFFECT THE ASPEN COVER TYPE

Western Tent Caterpillar: *Malacosoma californicum* Packard

Figure 10 displays acres of aspen defoliated by tent caterpillar on the San Juan and Rio Grande National Forests from 1978 to 1985. Defoliation in 1986 was negligible. At the peak in 1984 about 95,000 acres were defoliated by this insect.

Large Aspen Tortrix: *Choristoneura conflictana* (Walker)

Throughout Colorado, defoliation of the aspen type was observed. Large aspen tortrix was estimated to account for half of the aspen foliage damage with ink spot and leaf blight being responsible for the balance.

The most notable tortrix outbreaks occurred along the northwestern edge of North Park and the Telluride area on National Forest and adjacent lands.

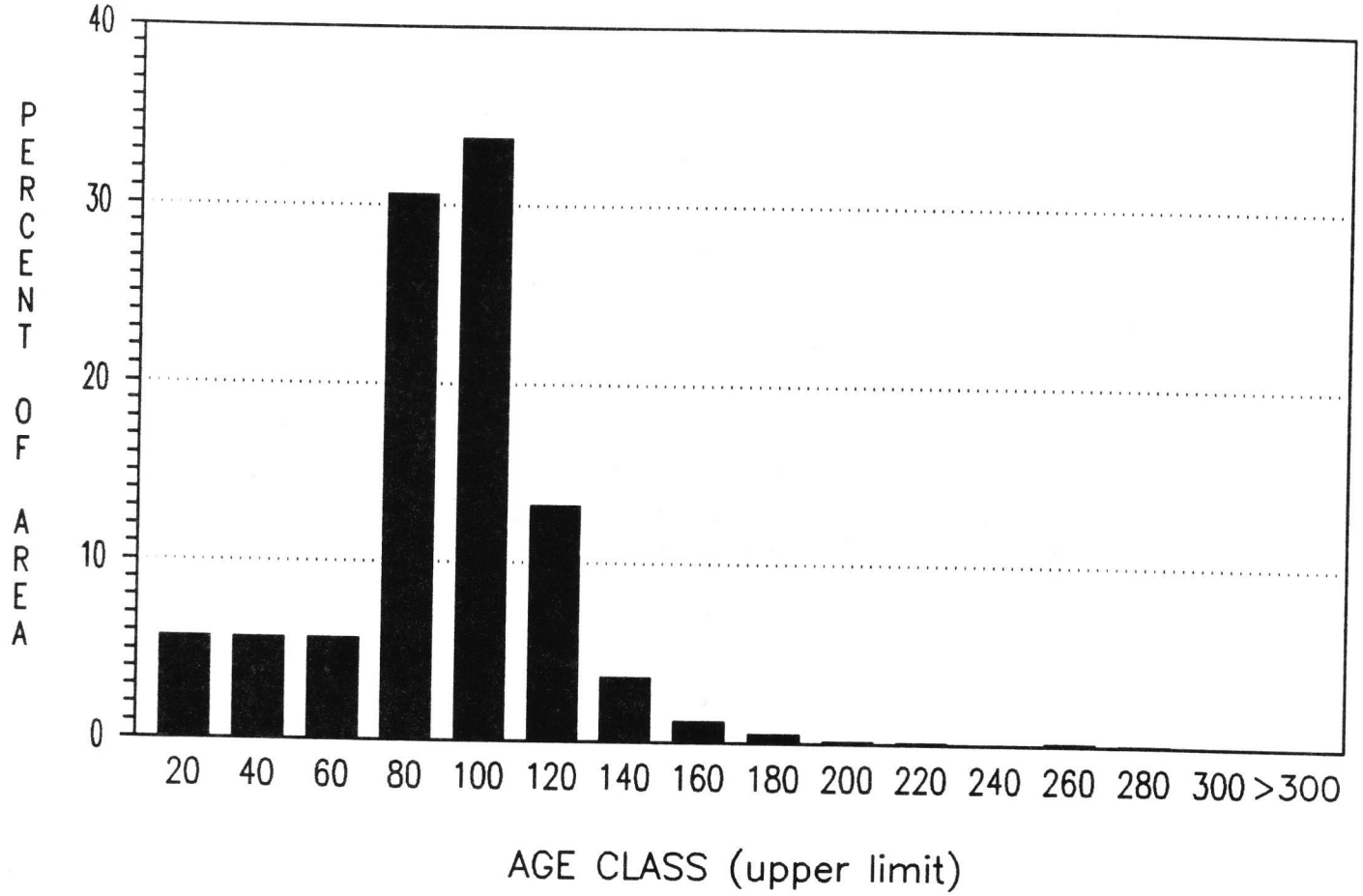

Figure 9: Percent of aspen covertype by age class in Region 2.

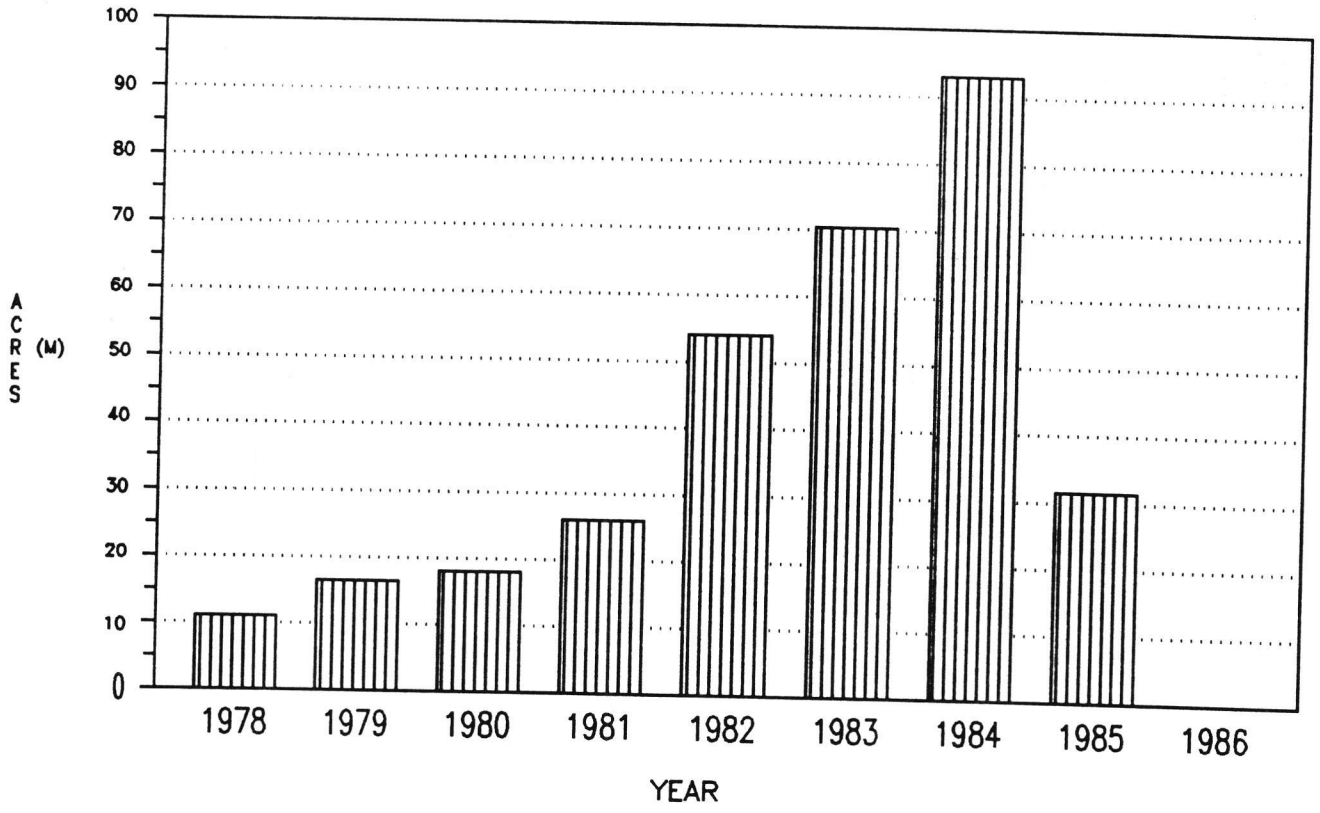

Figure 10: Acres of aspen defoliated by the western tent caterpillar in the Blanco Basin, V–Rock, and Chama Basin areas of the San Juan and Rio Grande National Forests and adjacent lands; 1978–1986.

Foliage Diseases

Aspen displayed their typical complement of foliage problems in 1986. Warm, moist weather late this spring encouraged the buildup of several foliage diseases including ink spot, Marssonina blight, and Shepherd's crook.

Sprout stands can be heavily infected by foliage diseases, especially Shepherd's crook. Some degree of foliage diseases in sprout stands are a normal part of the natural thinning process. An aspen stand regenerated following fire, would probably have this inoculum available in the duff.

Canker Diseases

Since aspen has living bark, it is susceptible to many canker diseases. Any mechanical wounding usually leads to canker disease and eventual death of the stem. When aspen stems are killed slowly by disease, sprout production tends to be greatly reduced. For these reasons, partial cutting of aspen is not recommended. Establishment of new campgrounds or picnic grounds in aspen stands is also discouraged.

SPRUCE/FIR COVER TYPE

Figure 11 displays the percent of area by age class for the spruce/fir cover type in the Region. Of the estimated 3.3 million acres of cover type on National Forest lands, 76 percent of the acres are between 81 and 220 years of age. There is an estimated 1.6 million acres of spruce/fir cover type on other Federal, State, and private lands in the Region.

On average, only 1.7 percent of the acres have been regenerated per decade over the past 80 years. Subalpine fir is not uncommon at 250 years of age and spruce at 500 years of age. This cover type is the most diverse in relation to age class distribution in the Region. The average annual volume harvested in the Region is about 46 million board feet (about 20.0% of the total Regional volume).

Spruce Beetle: *Dendroctonus rufipennis* (Kirby)

Spruce beetle remained endemic in 1986. A small local population developed in road right-of-way log decks on the Sulphur Ranger District, Arapaho National Forest. The infested logs will be removed and mill-processed before the beetles mature and fly in 1987.

Root Disease: *Armillaria* sp.

Armillaria root disease is common in mature spruce/fir forests. Root disease can result in hazardous trees, especially subalpine fir, on recreation sites. Several hundred acres near Turquoise Lake and Mary Queen Campgrounds on the Pike and San Isabel National Forest, Colorado, were found to contain small centers of Armillaria root rot in 1986.

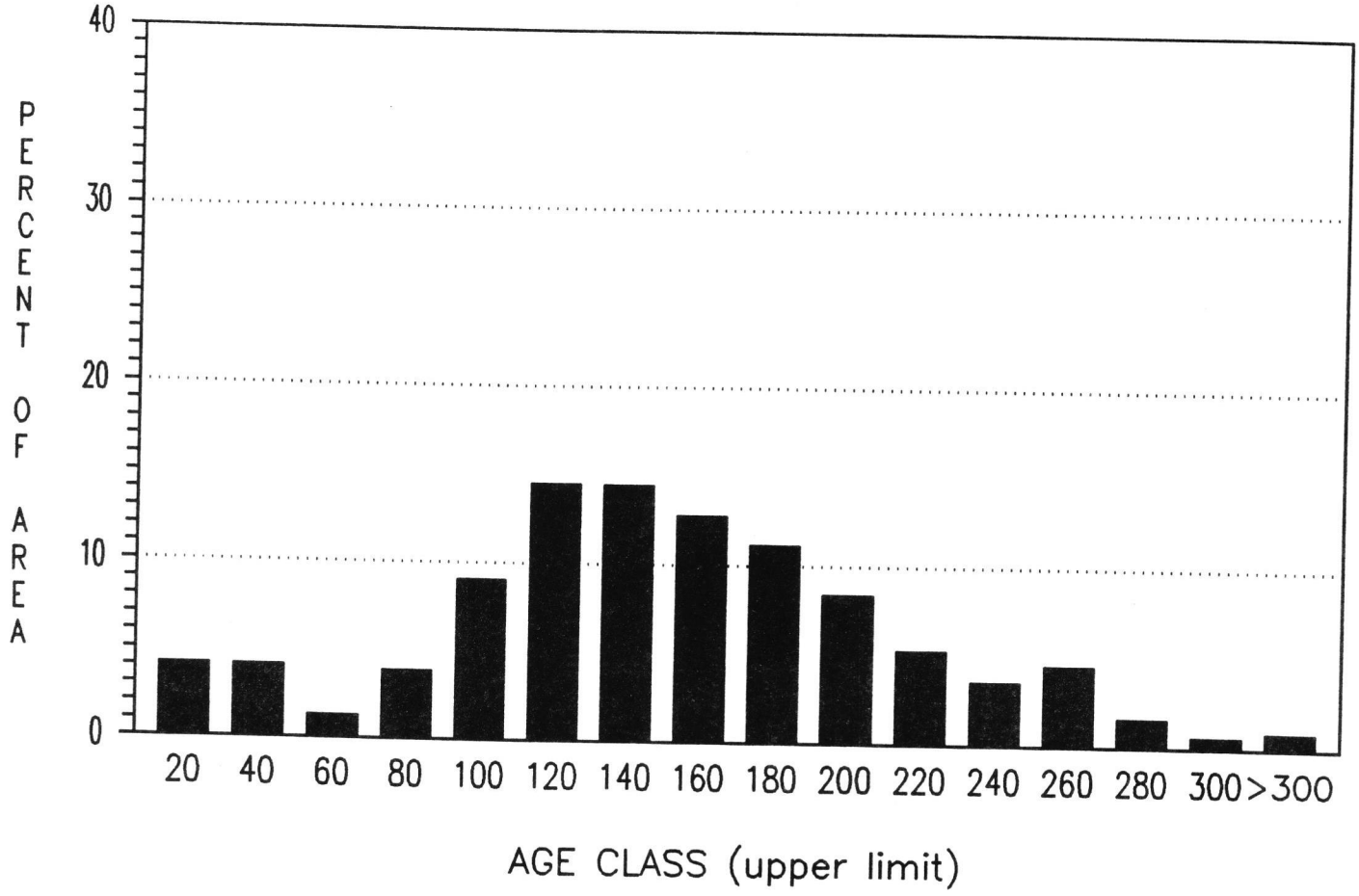

Figure 11: Percent of spruce/fir covertype by age class in Region 2.

PINYON/JUNIPER COVER TYPE

There are 283,000 acres of pinyon/juniper on the National Forests in the Rocky Mountain Region. Most of these acres are non-commercial woodlands concentrated in southern and western Colorado.

Root Diseases: Ceratocystis wageneri Goheen and Cobb and Armillaria sp.

Black stain root disease, caused by Ceratocystis wageneri, is fairly common on pinyon pine in southern Colorado, especially in Mesa Verde National Park. Armillaria root disease can become widespread on Rocky Mountain juniper, especially following environmental stress. Sanitation is important to prevent Ips spp. build-up and to reduce fire danger.

URBAN AND SHELTERBELT TREE PROBLEMS

Diplodia Tip Blight of Pines: Sphaeropsis sapinea (Fr.) Dyko & Sutton

Five successive years (1982-1986) of severe Diplodia tip blight has resulted in considerable damage, including mortality, to Austrian and ponderosa pines in eastern Nebraska. The damage has occurred primarily in older trees (over 30 years) in urban plantings (residential, parks) and in windbreaks. Damage during these five years has not been confined to new shoot growth; it has been extensive to older tissues, including mortality of major branches.

In Kansas, Diplodia blight is spreading from ornamental plantings in cities to windbreaks and recreation plantings. In South Dakota, the disease is scattered throughout ornamental and shelterbelt plantings, mostly occurring on ponderosa pine.

Dutch Elm Disease: Ceratocystis ulmi (Buism.) C.Mor.

This vascular wilt remains top priority for protection efforts in Colorado's urban forests. Dutch elm disease continues to be a problem throughout the Region in community plantings and in shelterbelts.

Gypsy Moth: Lymantria dispar (Linnaeus)

Pheromone trapping in the Region was done in cooperation with the USDA, Animal and Plant Health Inspection Service (APHIS). USDA, APHIS is charged with detection and eradication of gypsy moth infestations established as a result of transport of life stages into unregulated areas such as the Rocky Mountain Region.

Colorado

In 1985, 2662 gypsy moth pheromone traps were deployed statewide. Gypsy moth adults were trapped in Fort Collins and Boulder. In Fort Collins, four of the twenty traps deployed caught one moth each. In Boulder, two traps of the twenty deployed caught moths (ten moths in one and two moths in the other). Egg mass searches were conducted in the vicinity of all positive traps in both cities. No eggs were found.

In 1986, approximately 2800 traps were deployed statewide. Within Fort Collins and Boulder, grid trapping was conducted at densities of 10, 20, and 25 traps per square mile. The actual density for a given area was determined by its proximity to the positive 1985 traps. The trapping results were:

	Boulder	Fort Collins
Total Traps Deployed	185	197
Area Trapped (sq. miles)	6	20
Positive Traps	13	15
Area Represented by Positive Traps (sq. miles)	0.5	1.7
Total Moths Trapped	46	57

Subsequent, intensive egg mass searches in the vicinity of all positive traps resulted in the discovery of one egg mass in Boulder and one egg mass in Fort Collins. No Federal suppression activities are planned for 1987, however, each city in cooperation with the Colorado State Forest Service has developed and will execute a suppression program in the infested areas.

South Dakota

In 1986, approximately 1000 gypsy moth traps were deployed. For the first time since 1982, when trapping began, no gypsy moths were found.

Kansas

Approximately 672 pheromone traps were deployed in 1986. One of the traps caught one moth in Wyandotte County.

Wyoming

In 1986, 132 traps were set throughout the state. None of the traps in the Region Two portion of the state caught moths. However, one trap caught one moth at Yellowstone National Park, Wyoming in Region One.

NURSERY STUDIES

Russian-olive Tip Blight

Russian-olive at Big Sioux Nursery, South Dakota, have been suffering from a tip blight of unknown cause for the past few years. In 1985, the blight resulted in 50% cull of 1-0 stock, with 10-80% rows/bed affected. Blighted tissue yielded Alternaria sp., bacteria, Ascochyta sp., and Fusarium acuminatum Ell. and Ev. sensu Gordon. Top-pruned Russian-olive seedlings were inoculated twice with Fusarium acuminatum under controlled laboratory conditions.

No evidence of any kind of tip blight was found on any of the Russian-olive seedlings and the study was terminated 92 days after sowing (three weeks after the second inoculation). Fusarium acuminatum is apparently not the primary pathogen. The disease could be caused by a complex of organisms. Several Russian-olive seedlots are showing symptoms of the blight at the Big Sioux Nursery. Regular applications of benomyl and a few applications of Bordeaux mixture are currently keeping the disease under control at the Nursery.

Evaluation of Basamid Granular®

Basamid is granular dazomet, which reacts with soil and water to form methylisothiocyanate, a degradable biocide.

Bessey Nursery, Nebraska, requested an evaluation of Basamid as an alternative to methyl bromide fumigation. Beginning in summer, 1986, five treatments were compared: solar-heated, methyl bromide-fumigated, Basamid with a water seal, and Basamid with polyethylene tarp seal. The study area had nematode damage in the previous crop.

According to soil assays, Basamid Granular was as effective as methyl bromide fumigation for controlling plant-parasitic nematodes. Population levels of Pythium spp. were too low to show any treatment effects. For Fusarium spp., initial assays indicated that Basamid treatment was not effective. Solar heating was effective in reducing populations of Fusarium spp. and plant-parasitic nematodes, but not as effective as methyl bromide fumigation.

Eastern redcedar sown in fall, 1986, will be monitored for differences in survival and growth, and weed populations will be compared. In summer, 1987, population levels of plant parasitic nematodes and damping-off fungi, and seedling height, caliper, and dry weight will be compared.

Reforestation Improvement Program (RIP)

The Rocky Mountain Region began participation in a National study with a ponderosa pine crop sown at Bessey Nursery last spring. Standard procedures for soil pathogen assay were developed by TFP&CFM Nursery Pathologists in February, 1986, and the procedures are working well.

TREE HEALTH MANAGEMENT MODULE

The Tree Health Management Series (THMS) is a new informational and educational module under development in Region 2. The series goes beyond the concepts developed in the Hazard Tree Instructor Training (HTIT) module developed in 1982.

THMS is a multivolume slide/tape and video tape module. Its objective is to SENSITIZE, INFORM, and EDUCATE public and private resource managers on HOW TO REDUCE RISK and DEVELOP a positive health management program. Current volumes address sensitivity training and developing competent tree inspectors. Volumes under development and planned are: vegetation management; integration of landscape design and pest management; and liability, the law, and you.

Rocky Mountain Region--Summary of diseases in Colorado, Kansas, Nebraska, South Dakota, and central and eastern Wyoming

Disease	Host	Location	Remarks
STEM AND BRANCH DISEASES			
Comandra blister rust *Cronartium comandrae*	Lodgepole pine	Wyoming	Continues as the most serious disease of lodgepole pine on the Wind River Ranger District, Shoshone National Forest, where more than half of the mature trees are infected and 85 percent of infected trees have dead tops.
Dwarf mistletoes			
Arceuthobium americanum	Lodgepole pine	Colorado, Wyoming	Remains the most important disease on Federal lands in the Region. Found on about 518,000 acres in Colorado and 361,000 acres in eastern and central Wyoming, it causes mortality and growth loss equal to approximately 10 million cubic feet. Presuppression surveys were conducted on 23,000 acres on three National Forests. Silvicultural control was conducted on 2,410 acres on eight National Forests.
Arceuthobium vaginatum subsp. *cryptopodum*	Ponderosa pine	Colorado	Approximately 20 percent of the host type is infested. Annual losses amount to over 885,000 cubic feet. Most common in the *Pinus ponderosa*/*Muhlenbergia montana* habitat type.
Poplar cankers			
Dothichiza populea *Valsa sordida* [*Cytospora chrysosperma*] *Phomopsis macrospora*	Cottonwood, hybrid poplars, Lombardy poplar	South Dakota	Common Statewide.
Russian-olive canker *Phomopsis* or *Tubercularia* sp.	Russian-olive	South Dakota	For the last few years, causing mortality in shelterbelts. Incidence highest in areas affected by drought and grasshopper populations.
Siberian elm canker *Botryodiplodia hypodermia*	Siberian elm	South Dakota	Declining and dying of elms throughout the State continues. Herbicide damage is suspected as one of the stress factors.

Rocky Mountain Region--Summary of diseases in Colorado, Kansas, Nebraska, South Dakota, and central and eastern Wyoming--Continued

Disease	Host	Location	Remarks
Thyronectria canker *Thyronectria austro-americana*	Honeylocust	Colorado Kansas	Continues as an urban tree problem along the Front Range. Continues to be a problem in Kansas windbreaks.
ROOT DISEASES			
Armillaria root disease *Armillaria* spp.	Subalpine fir, Engelmann spruce	Colorado	Several hundred acres near Turquoise Lake and May Queen Campground on the Pike and San Isabel National Forest, Colorado, contain clusters of small centers of Armillaria root rot.
FOLIAGE DISEASES			
Anthracnoses, leaf spots *Gnomonia leptostyla* and unidentified species	Hardwoods	South Dakota Kansas	Wet, warm weather in parts of S. Dakota favored these diseases. Walnut anthracnose was severe in eastern Kansas.
Ink spot, leaf blight, and shepherd's crook *Ciborinia whetzelli* *Marssonina populi* *Pollaccia radiosa*	Aspen	Colorado	Warm moist weather in the Spring encouraged the buildup of aspen foliage diseases.
Juniper blight *Phomopsis juniperovora* *Cercospora sequoiae* *Kabatina juniperi*	Eastern redcedar, Rocky Mountain juniper	South Dakota Nebraska	Incidence increasing in South Dakota. Caused serious problems in scattered areas of eastern Nebraska.
Diplodia blight *Sphaeropsis sapinea* (=*Diplodia pinea*)	Ponderosa pine, Austrian pine	South Dakota Nebraska Kansas	Present in shelterbelts in South Dakota. Severe infections for the last five years in eastern Nebraska are resulting in branch dieback and tree mortality in urban and windbreak plantings. Spreading from ornamental plantings in cities to windbreaks and recreation plantings in Kansas.
Dothistroma needle blight *Dothistroma pini*	Austrian pine	Nebraska	Caused extensive defoliation in many young pine plantings in eastern Nebraska.
Brown spot needle blight *Scirrhia acicola*	Austrian pine Scots pine	Kansas	Isolated case on Austrian pine in Lyons County. Very common on Scots pine.

Rocky Mountain Region--Summary of diseases in Colorado, Kansas, Nebraska, South Dakota, and central and eastern Wyoming--Continued

Disease	Host	Location	Remarks
Needlecasts			
Lophodermella concolor *Lophodermella montivaga*	Lodgepole pine	Colorado	Collected on the Fraser Experimental Forest near Fraser, CO. Noted in areas near Winter Park and Granby, CO.
Leptomelanconium cinereum	Lodgepole pine	Colorado	Infecting last years needles of approximately 100 acres of sapling and pole-size lodgepole pine in an area of heavy mountain pine beetle mortality on the Holy Cross Ranger District, White River National Forest.
Species undetermined	Lodgepole pine	Colorado	Various needlecasts were widespread along the Front Range, on the Routt, Arapaho, and San Isabel National Forests. This is the second year that needlecasts have been observed, probably due to weather conditions favorable for infection.
Shoot blight *Sirococcus strobilinus*	Blue spruce	South Dakota	Present in shelterbelts.
Honeysuckle leaf blight *Insolibasidium deformans*	Honeysuckle	Colorado	Infecting windbreak plantings in Colorado State Forest Service Nursery.
VASCULAR WILTS			
Dutch elm disease *Ceratocystis ulmi*	Elm species, including American elm	Colorado, Nebraska, South Dakota	Remains top priority for protection efforts in Colorado's urban forests. Continues to be a problem throughout Nebraska. In South Dakota, the disease continues to kill 6 to 10 percent of the remaining American elms in communities without management programs.
NURSERY DISEASES			
Phomopsis blight *Phomopsis juniperovora*	Eastern redcedar	Nebraska	Although 25 percent of the 2-0 *Juniperus virginiana* at Bessey Nursery were affected by the blight, immediate response by the Nursery with regular sprayings of benomyl and roguing of infected foliage limited losses to 8 percent.

Rocky Mountain Region--Summary of diseases in Colorado, Kansas, Nebraska, South Dakota, and central and eastern Wyoming--Continued

Disease	Host	Location	Remarks
Cytospora canker *Cytospora* spp.	Cottonwood, poplar	Colorado	At the Colorado State Forest Service Nursery, replacing coppice stools with canker resistant strains is helping to alleviate the problem.
Tip blight causal agent unknown	Russian-olive	South Dakota	Russian-olive at Big Sioux Nursery has been damaged by a tip blight of unknown etiology for the past few years. Several seedlots are showing symptoms, but regular applications of benomyl and a few applications of Bordeaux mixture are currently keeping the disease under control. *Fusarium acuminatum* was one potential pathogen isolated from blighted tissue. Inoculation of top-pruned 2-month-old Russian-olive seedlings under controlled laboratory conditions did not result in tip blight.
ABIOTIC Drought	Many species	South Dakota	Hot, dry winds damaged newly planted trees, especially conifers in the central portion of the State.
Herbicide damage	All species	South Dakota	Continues as a major problem in the eastern half of the State.
Frost damage	Hardwoods	Colorado, South Dakota	Late winter was unusually warm and dry, and some trees leafed out several weeks early. Late spring cold spells resulted in frost injury to many species.
Winter damage	Hardwoods and conifers	South Dakota	Several severe winter blizzards caused top breakage, blowdown, snow damage, winter burn and winter kill especially in the eastern and southeastern parts of the State. Deep snows also forced rabbits and deer into shelterbelts. Some belts in Dewey, Ziebach, and Perkins Counties had virtually every tree girdled or severely nipped back.

Rocky Mountain Region--Summary of diseases in Colorado, Kansas, Nebraska, South Dakota, and central and eastern Wyoming--Continued

Disease	Host	Location	Remarks
Ponderosa pine decline	Ponderosa pine	South Dakota	Shelterbelts are recovering from an unexplained decline and mortality of 20- to 80-year-old pines in shelterbelts in southeast South Dakota. Diplodia blight, fluctuating water tables, and infestation by pitch nodule makers were implicated.

Rocky Mountain Region--Summary of insects in Colorado, Kansas, Nebraska, South Dakota, and central and eastern Wyoming

Insect	Host	Location	Remarks
Ash borer/lilac borer *Podosesia syringae*	Green ash	South Dakota	One shelterbelt was heavily infested (50 trees on 3 acres) in Brule County.
Cankerworms *Alsophila pometaria* *Paleacrita vernata*	Elm Honeylocust Hackberry	Kansas South Dakota	Cankerworm damage was again quite severe in the eastern half of Kansas. Light damage was noted in South Dakota.
Cedar bark beetles *Phloeosinus* spp.	Eastern redcedar Rocky Mountain juniper	Nebraska	An outbreak in central Nebraska caused significant damage to juniper and redcedar windbreaks.
Dioryctria pine moths *Dioryctria* spp.	Ponderosa pine Scotch pine	Nebraska South Dakota	Continued to be a problem in pines of South Dakota and Nebraska.
Douglas-fir beetle *Dendroctonus pseudotsugae*	Douglas-fir	Colorado, Wyoming	Mortality continues primarily in Colorado.
Douglas-fir tussock moth *Orgyia pseudotsugata*	Douglas-fir, spruce	Colorado	Light defoliation occurred in the Rampart Range/Platte River drainage. Long term assessment plots are being established to monitor population changes and resultant damage to host species. Adult trapping indicates a static endemic population from 1985 to 1986.
Eriophyid mites	Ornamentals	Colorado	Vagrant forms of eriophyid mites are again being found in high numbers on "all" hosts. They appear to be causing a wide range of leaf injury. Symptoms range from total browning/death of leaves to curling and discoloration suggestive of herbicide injury.
European pine sawfly *Neodiprion sertifer*	Pine	Kansas	European pine sawflies were reported in a number of Christmas tree plantations in the northwest part of Kansas. In the past the pine sawfly problem was mainly limited to the extreme eastern part of the State near the Kansas City area.

Rocky Mountain Region--Summary of insects in Colorado, Kansas, Nebraska, South Dakota, and central and eastern Wyoming--Continued

Insect	Host	Location	Remarks
Gypsy moth *Lymantria dispar*	Hardwoods	South Dakota Kansas Colorado	South Dakota experienced the first year since 1982 without finding Gypsy moth in annual detection surveys. Detection surveys in Boulder and Fort Collins trapped 46 and 56 Gypsy moth adults, respectively. No other life stages were found. No adults were trapped in Kansas.
Honeysuckle aphid *Hyadaphis tartaricae*	Honeysuckle	South Dakota	Honeysuckle aphid was found in three new counties: Fall River, Custer, and Perkins. Only three counties in the State remain where the aphid has not yet been located: Harding, Butte, and Shannon. Permanent damage evaluation plots, established in 1984, showed an increase in extent and intensity of damage. However, the bushes continued to increase in height and mortality was negligible. Overall, the older honeysuckle rows are still providing cover to the lower levels of the shelterbelts.
		Colorado	Honeysuckle aphid was determined to be a new pest to the Colorado State Forest Service Nursery.
Introduced pine sawfly *Diprion similis*	Pine	South Dakota	The introduced pine sawfly was first found in eastern South Dakota in 1985. During 1986, an infestation was discovered in the provenance tests and shelterbelts at the Division's Big Sioux Nursery. An evaluation determined that 56% of the overwintering (86-87) cocoons were parasitized. Little damage was done in 1986 and little is expected in 1987.
Juniper sawfly *Monoctenus fulvus*	Juniper	Kansas	Juniper sawfly damage was observed to be quite severe in several windbreaks but most of the damage was reported on ornamentals and recreation area trees.

Rocky Mountain Region--Summary of insects in Colorado, Kansas, Nebraska, South Dakota, and central and eastern Wyoming--Continued

Insect	Host	Location	Remarks
Large aspen tortrix *Choristoneura conflictana*	Aspen	Colorado	Several areas of moderate to severe defoliation occurred throughout the State. The most notable outbreaks occurred along the northwestern edge of North Park and in the Telluride area on National Forest and adjacent lands.
Mountain pine beetle *Dendroctonus ponderosae*	Limber pine, lodgepole pine, ponderosa pine	Colorado, South Dakota, Wyoming	Mountain pine beetle declined in the Black Hills of South Dakota and Wyoming in 1986. This infestation, which is at a 16 year low, is expected to increase in 1987. Populations on Casper and Muddy Mountains declined in 1986. The Casper Mountain Pine Beetle Association has proposed a two phase action plan with emphasis on stand management to reduce susceptibility to mountain pine beetle and wildfire. In Colorado, mountain pine beetle in lodgepole pine continued to decline in the High Country Project area during 1986 for the second consecutive year. Mountain pine beetle in ponderosa pine associated with roundheaded pine beetle on the Uncompahgre Plateau and Dolores River areas also declined. The emphasis is on stand management to reduce infestation populations and stand susceptibility. Currently, limited markets inhibit the rate of stand management. Hopefully, this problem will improve before the bark beetle infestations rebuild.
Nantucket pine tip moth *Rhyacionia frustrana*	Pine	Kansas	Pine tip moth damage was greatly reduced in the northeast part of Kansas but, damage was above normal in the south-central part of the State.
Pine budworm *Choristoneura lambertiana*	Ponderosa pine Limber pine	Colorado Wyoming	Defoliation levels declined in south-western Colorado but remained static elsewhere in the State. For the first time in recent years, defoliation of limber pine was reported west of Lander, Wyoming.

Rocky Mountain Region--Summary of insects in Colorado, Kansas, Nebraska, South Dakota, and central and eastern Wyoming--Continued

Insect	Host	Location	Remarks
Pine butterfly *Neophasia menapia*	Ponderosa pine	Colorado	Spotty populations continue to occur in southwestern Colorado.
Pine engravers *Ips* spp.	Ponderosa pine	South Dakota Nebraska	The *Ips* beetle outbreak which began in 1984 in the Black Hills returned to near endemic levels in 1986. In Nebraska, beetle-caused tree mortality occurred near thinnings.
Pine needle scale *Chionaspis pinifoliae*	Spruce, Pine	South Dakota	Scattered trees with infestations in four counties in South Dakota.
Pine tip moths *Rhyacionia* spp.	Ponderosa pine Scotch pine	South Dakota Nebraska	Scattered infestations ranging from 1 to 50 trees infested. Continued to be a problem on young pines throughout Nebraska.
Spruce beetle *Dendroctonus rufipennis*	Spruce	Colorado	Remains endemic, some low populations occur in road right-of-way decks, Sulphur Ranger District, Arapaho National Forest. The logs and beetles are expected to be processed through the sawmill before the beetles mature.
Walnut caterpillar *Datana integerrima*	Walnut	Kansas	Walnut caterpillar damage was almost non-existent compared to previous years. Individual trees were defoliated but few growers reported any damage.
Western spruce budworm *Choristoneura occidentalis*	Douglas-fir, Engelmann spruce, White fir	Colorado, Wyoming	The area of visible defoliation in the Region continued to decline from 1.6 million acres in 1985 to 1.1 million acres in 1986. Despite the decline, there were several areas of extreme defoliation scattered throughout the Region. The decline in the area of visible defoliation is expected to continue.
Western tent caterpillar *Malacosoma californicum*	Aspen,	Colorado	As predicted, populations in the chronically infested area southeast of Pagosa Springs continued to decline to nearly endemic levels. This outbreak which began in 1977 reached a peak of 70,000 acres in 1983. It left in its wake many dead and dying aspen.

USE OF HERBICIDES IN REGION 2 FOR 1981-1986
(MAJOR HERBICIDE USES ONLY) 1/

Herbicide	Application	1981	1982	1983	1984	1985	1986
		----------Acres Treated----------					
2,4-D	Ground	1,155	585	1,011	1,971	2,243	2,857
2,4-D	Aerial	14,297	15,646	8,287	2/	2/	2/
Picloram (Tordon)	Ground	2,202	3,161	2,151	2,782	2,452	3,167
Glyphosate (Roundup)	Ground	197	242	98	235	102	244
Dicamba (Banvel)	Ground	399	291	153	339	292	295

1/ Major target species are big sagebrush, sand sagebrush, Canada thistle, leafy spurge, Wyethia, and various broadleaf weeds for range improvement and roadside management projects.

2/ No aerial application of herbicides in FY 84, 85, or 86.

PESTICIDE USE IN REGION 2 IN FY 86 [1/]

Type of Pesticide	Chemical Used	Target Pest	Units Treated [2/]
Fumigant	Methyl bromide chloropicrin	Nematodes and Fusarium root rot in nursery beds	14
Fungicide	Benomyl	Phomopsis blight in eastern redcedar nursery stock	60
	Dodine	Shothole disease in nursery stock	4
Herbicide	Ammonium sulfamate	Poisonous plants	35
	Chlorsulfuron	Noxious weeds	5
	Dacthal	Nursery weeds	47
	Dicamba	Noxious weeds	305
	Glyphosate	Conifer release	35
	Glyphosate	Noxious weeds	189
	Glyphosate	Nursery weeds	20
	Hexazinone	Conifer release	35
	Picloram	Noxious weeds	3,065
	Picloram	Range improvement	70
	Picloram	Poisonous plants	82
	Simazine	Poisonous plants	1
	Tebuthiuron	Conifer release	100
	2,4-D	Range vegetation	743
	2,4-D	Noxious weeds	1,425
	2,4-D	Poisonous plants	50
	2,4-D/Dicamba	Noxious weeds	339
Insecticide	*Bacillus thuringiensis*	Mosquitoes	1
	Carbaryl	Mountain pine beetle	1,542 trees
	Carbaryl	Western spruce budworm	8
	Coumaphos	Cattle ticks & lice	12,000 head
	Dimethoate	Tip moths	4
	Lindane	Bark beetles	1,552 trees
	Malathion	Grasshoppers	121,730
Rodenticide	Aluminum phosphide	Ground squirrels	150 burrows
	Aluminum phosphide	Prairie dogs	56
	Aluminum phosphide	Prairie dogs	200 burrows
	Strychnine	Pocket gophers	1,414
	Zinc phosphide	Prairie dogs	11,632
Piscide	Antimycin	Undesirable fish	17

1/ Includes use by the USDA Forest Service, other Federal Agencies, permittees, licensees, and grantees.

2/ Units are in acres unless otherwise indicated.

ACTIVE PROJECTS
(*Denotes FPM Involvement)

The following includes a listing of currently active research projects by organization and insitiution.

ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

FORT COLLINS, COLORADO

Project RM-4501, "Development of forest pest assessment technology for the Rocky Mountain West," is just getting underway, so the studies that will be conducted have not all been identified. Research under the new charter will include root diseases, hard pine rusts, dwarf mistletoes, and spruce budworm. Some ongoing studies listed below will continue.

Dwarf Mistletoes

* 1. Silvicultural control of dwarf mistletoe in young lodgepole pine stands (FPM, RMFRES).

2. The role of animals in long-distance dispersal of lodgepole dwarf mistletoe (RMFRES, North Central FES).

3. Effects of dwarf mistletoes on growth and yield in thinned lodgepole pine and ponderosa pine stands (RMFRES).

4. Development and refinement of growth and yield simulation models for dwarf mistletoe-infested stands in the Interior West (RMFRES, MAG).

5. Investigation of the taxonomy, hosts, and distribution of the dwarf mistletoes in North America (RMFRES, Univ. of Utah, Ohio State Univ.).

6. Development of a yield simulation model for mistletoe-infected, irregular ponderosa pine stands (RMFRES, Colo. State Univ.).

* 7. Ethephon for control of lodgepole pine dwarf mistletoe in recreation forests (North Central FES, RMFRES, FPM, Arapaho-Roosevelt NFs).

8. Intensification of Douglas-fir dwarf mistletoe in the Southwest and Pacific Northwest. (RMFRES, No. Ariz. Univ., Region 6 - FPM, PNW Stn.).

Hard Pine Rusts

1. Hazard-rating and ecology of comandra blister rust in the Rocky Mountain Region (RMFRES, Colo. State Univ.).

2. Management of lodgepole pine infected by comandra blister rust in the Rocky Mountain Region (RMFRES, Colo. State Univ.).

3. Development of rating system for limb rust in ponderosa pine (RMFRES, Utah State Univ.).

Root Diseases

1. Completion and validation of the Western Root Disease Model (RMFRES and cooperators).

LINCOLN, NEBRASKA

The Research Work Unit Description for the Lincoln Unit of the RM station was approved for a five-year period in October, 1986. The Unit's mission is: To select adapted tree species; to develop genetically improved seed; and to reduce the impact of diseases and insects on trees in the Great Plains. The three problems assigned to this unit are: (1) Presently used tree provenances do not survive and grow well or tolerate disease and insect attack adequately; (2) Information on the factors influencing infection and disease development is not adequate for developing management strategies to reduce the impact of diseases on major tree species planted in the Great Plains; and (3) Technologies for the early detection, assessment, and control of major seed-damaging, boring, and defoliating insects are not adequate to achieve desired improvements in seed production, tree survival, and tree growth.

COLORADO STATE UNIVERSITY

SHADE TREE RESEARCH (W.R. Jacobi)

Thyronectria Canker: Thyronectria austro-americana (Speg.) Seeler

Research completed this year by Dr. William Jacobi at CSU included studies on honeylocust resistance to Thyronectria austro-americana, correlation of soil salt concentrations with incidence of Thyronectria canker and the influence of low osmotic water potentials on the growth of T. austro-americana. Thornless honeylocust seedlings had significantly smaller cankers than Imperial, Skyline and Sunburst cultivars. Sunburst had significantly larger (P=0.05) cankers than those found on the other cultivars. Thornless seedlings callused and covered inoculated wounds twice as fast as other selections. The effect of girdling on canker expansion was not apparent in fall inoculated trees, but there were significantly larger (P=0.05) cankers above girdled areas in spring inoculated trees. There was an apparent difference between canker size resulting from the two isolates used in inoculations. Canker expansion was greatest during the fall and spring.

The location of canker incidence in a commercial nursery was significantly related to electrical conductivity (Ca, Mg, and Na ion concentrations). Although there were significant correlations, soil variables explained only about 35% of the canker incidence variation. An increase in osmotic potentials caused a significant (P=0.05) reduction in growth of T. austro-americana in liquid culture. Growth decreased from normal conditions at -4 bars with decreasing osmotic stress.

Water Stress Studies

The effects of drought and water stress on Thyronectria canker expansion on honeylocusts are being studied. No effect of drought has been detected at this point in this study. Also being studied is the effect of water stress on the growth of the canker pathogen Thyronectria austro-americana. Results indicate the fungus grows best at low water stress conditions but can grow at -60 to -70 bars.

Root Collar Rot

Work is continuing on the prevention of root collar rot on overwatered honeylocusts. Prevention work revolves around the removal of soil around the tree base and replacement with gravel. It is expected that results will not be available for several years.

Fungicide Screening

Work continues on screening fungicides for the prevention of Thyronectria cankers of honeylocusts and Marssonina leaf spot on aspen. The fungicides being screened at this time are benomyl, cupric hydroxide, chlorothalonil, bayleton, triflorine, thiophanate methyl, and mancozeb.

Droopy Aspen Disease

Three plots have been established in Aspen and Frisco, Colorado, to assess the effects of tetracycline injections on droopy aspens. The cause of the drooping aspen disease is not known, but the tests should indicate whether a mycoplasma-like organism is involved since tetracyclline affects mycoplasmas. The disease is found throughout the Front Range and mountain communities.

FOREST TREE RESEARCH

Cytospora canker of aspen (Annette Ramaley, Graduate Student)

Several studies on Cytospora canker of aspen are continuing: the length of time wounds remain susceptible, the mode of entry of the pathogen, and its presence or absence as a normal bark epiphyte. Another study is determining whether vegetation compatability groups exist in the Cystospora chrysosperma population. On potted greenhouse trees, wounds remained susceptible on day 0 and 2 but not at one week. Cystospora has not been found in bark, but it is common on the bark surface.

Development of a damage rating system for comandra blister rust (Jane Boyd, Graduate Student

A system is being developed for predicting the occurrence and amount of comandra rust in lodgepole pine in the Rocky Mountains. The work will focus on weather conditions related to episodes of rust infection and continue the work of Ralph Zentz on the relationship of the alternate host on rust incidence. Permanent plots are also being established throughout Wyoming, Utah, and Montana to quantify rust impact on stand productivity. This project was initiated in May 1986.

RECENT PUBLICATIONS

(* Available from FPM)

Amman, G. D., and Pasek, J. 1986. Mountain pine beetle in ponderosa pine: effects of phloem thickness and egg gallery density. USDA For. Serv., Intermountain Research Station, Research Paper INT-367. 7 pp.

Baker, F. A., Rabin, D., Chengguo, W., and Tkacz, B. M. 1987. Rating the severity of limb rust in ponderosa pine stands. Pages 22-23 in Cooley, S. J. (compiler), Proc. 34th WIFDWC, Sept. 9-12, 1986, Juneau, Alaska.

Dix, M. E. 1986. Lilac seed, an alternative host for the ash seed weevil Lignyodes bischoffi (Blatchley). J. Kansas Entomol. Society 59: 389-390.

Dix, M. E., and Jacobson, M. (In Press). Trap preferences of Retinia metallica (Lepidoptera: Tortricidae: Olethreutidae) and seasonal flight behavior of Retinia spp., Rhyacionia spp. (Tortricidae), and Chionodes spp. (Gelechiidae) in the Dakotas. J. of the Lepidopterists Society.

Dix, M. E.; Pasek, J. E.; Harrell, M. O.; and Baxendale, F. P. (Technical Coordinators) (In Press). Common insect pests of trees in the Great Plains. Nebraska Cooperative Extension Service EC-86- . Univ. Nebraska Institute of Agric. and Natural Resources, Lincoln.

Dorset, Richard. 1986. South Dakota forest, shelterbelt, and ornamental tree pest status report 1985. Dept. Agric., Div. For. 34 pp.

Dorset, Richard. 1986. Shelterbelt insect and disease evaluation. South Dak. Dept. Agric., Div. For., For. Pest Surv. No. 83-4, Aug. 1986. 20 pp.

Dorset, Richard. 1986. 1986 Gypsy moth detection survey and evaluation. South Dak. Dept. Agric., Div. For., For. Pest Surv. No. 86-3, Nov. 1986. 10 pp.

Dorset, Richard. 1986. South Dakota Forest, shelterbelt, and ornamental pest status report 1984. South Dak. Dept. Agric., Div. For. 28 pp.

Dorset, Richard. 1987. Honeysuckle aphid spread and damage evaluation for 1986. South Dak. Dept. Agric., Div. For., For. Pest Surv. No. 86-1, Jan. 1987. 15 pp.

Dorset, Richard. 1987. Ponderosa pine decline and mortality, second year evaluation results. South Dak. Dept. Agric., Div. For., For. Pest Surv. No. 86-2, Jan. 1987. 15 pp.

Geils, B. W. 1987. Status and direction of studies on comandra blister rust in the Rocky Mountains. Pages 24-26 in Cooley, S. J. (compiler), Proc. 34th WIFDWC, Sept. 9-12, 1986, Juneau, Alaska.

Hart, J.M. 1986. Interaction among elk, fungi, and aspen in Rocky Mountain ecosystems. Phytopathology 76:1058. (abstract).

* Hildebrand, D.M., 1986. Effects of solar heating of soil on plant pathogens and thermotolerant microorganisms antagonistic to pathogenic Fusarium spp. in Colorado and Nebraska tree nurseries. Ph.D. Thesis, Univ. Colo., Boulder. 101 pp.

* Hildebrand, D.M. 1986. Fusarium acuminatum and a tip blight of Russian olive. USDA For. Serv., Rocky Mountain Region, Biol. Eval. R2-86-1. 3 pp.

* Hildebrand, D.M. 1986. Effects of soil solar heating on thermotolerant microorganisms antagonistic to pathogenic Fusarium spp. at Bessey Nursery, Halsey, Nebraska. USDA For. Serv., Rocky Mountain Region, Tech. Rep. R2-37. 10 pp.

Jacobi, W.R., Boyd, J.E., and Zentz, W.R. 1987. Comandra rust damage and risk rating research. Pages 29-30 in Cooley, S.J. (compiler), Proc. 34th WIFDWC, Sept. 9-12, Juneau, Alaska.

* Johnson, D.W. 1986. A summary of dwarf mistletoe program activities in the Rocky Mountain Region -- 1970-1986. USDA For. Serv., Rocky Mountain Region Tech. Rep. R2-36. 24 pp.

* Johnson, D.W. 1986. Comandra blister rust. USDA For. Serv., Forest Insect and Disease Leaflet 62. 8 pp.

* Johnson, D.W., and O'Neil, C.G. 1986. Forest Pest Conditions in the Rocky Mountain Region for 1985. USDA For. Serv., Rocky Mountain Region. 48 pp.

* Johnson, D.W. 1987. Dwarf mistletoe program planning for the Rocky Mountain Region -- 1987-1991. USDA For. Serv., Rocky Mountain Region, Tech. Rep R2-38. 6 pp.

Juzwik, J., French, D.W., and Hinds, T.E. 1986. Encoelia pruinosa on Populus tremuloides in Minnesota: occurrence, pathogenicity, and comparison with Colorado isolates. Can. J. For. Res. 64: 2728-2731.

Lessard, G., and Raimo, B. 1986. Douglas-fir tussock moth, Orgyia pseudotsugata (McDunnough), Pike National Forest. USDA For. Serv., Rocky Mountain Region, Biol. Eval. R2-86-3. 10 pp.

* Lister, C. K., and Sharon, E. M. 1986. Western spruce budworm of the Cuchara Valley Ski Area and Planned Expansion Area. USDA For. Serv., Rocky Mountain Region, Biol. Eval. R2-85-10. 6 pp.

Maffei, H. M., Hawksworth, F. G., and Jacobi, W. R. 1986. Growth and mortality effects of dwarf mistletoe on uneven-aged ponderosa pine stands in Colorado. Phytopathology 76: 1113. (abstract)

Mathiasen, R. L. 1986. Infection of young Douglas-firs and spruces by dwarf mistletoes in the Southwest. Great Basin Naturalist 46: 528-534.

Mathiasen, R. L., Blake, E. A., and Edminster, C. B. 1986. Estimates of site potential for Douglas-fir based on site index for several southwestern habitat types. Great Basin Naturalist 46: 277-280.

Merrill, L. M., Hawksworth, F. G., and Jacobi, W. R. 1987. Frequency and severity of ponderosa pine dwarf mistletoe in relation to habitat type and topography in Colorado. Plant Disease 71: 342-344.

Nickrent, D. L. 1986. Genetic polymorphism in the morphologically reduced dwarf mistletoes (Arceuthobium, Viscaceae): an electrophoretic study. Amer. J. Bot. 73: 1492-1502.

Nicholls, T. H., Egeland, L., Hawksworth, F. G., and Johnson, D. W. 1987. Control of dwarf mistletoe with ethephon. Pages 78-85 in Cooley, S. J. (compiler), Proc. 34th WIFDWC, Sept. 9-12, 1986, Juneau, Alaska.

Nicholls, T. H., Hawksworth, F. G., and Egeland, L. 1987. Animal vectors of Arceuthobium americanum on lodgepole pine. Page 96 in Cooley, S. J. (compiler), Proc. 34th WIFDWC, Sept. 9-12, 1986, Juneau, Alaska.

Peterson, G. W., Tech. Coord. 1986. Recent research on conifer needle diseases; Proc. IUFRO Working Party on Needle Diseases Conf., Oct. 14-18, 1984, Gulfport, MS. USDA For. Serv., Gen. Tech. Rep. WO-50. 106 pp.

Peterson, G. W. 1986. Resistance to Phomopsis juniperovora in geographic seed sources of Juniperus virginiana. Pages 65-69 in Recent research on conifer needle diseases; Proc. IUFRO Working Party on Needle Diseases Conf., Oct. 14-18, 1984, Gulfport, MS. USDA For. Serv., Gen. Tech. Rep. WO-50. 106 p.

Peterson, G. W. 1986. Resistance to Cercospora sequoiae var. juniperi greater in Juniperus virginiana than in J. scopulorum progenies. (Abstract) Phytopathology 76: 1113.

* Raimo, B.J. 1986. Douglas-fir tussock moth detection survey on the Pike and Arapaho National Forests 1985. USDA For. Serv., Rocky Mountain Region, 3420 Detection Report. 12 pp.

* Raimo, B.J. 1986. Western spruce budworms in the Rocky Mountain Region. USDA For. Serv., Rocky Mountain Region, Biol. Eval. R2-85-6. 18 pp.

* Raimo, B.J. 1985. Western tent caterpillar, Blanco Basin, "V" Rock, Chama Basin Areas, San Juan and Rio Grande National Forests. USDA For. Serv., Rocky Mountain Region, Biol. Eval. R2-85-7. 9 pp.

Riffle, J.W. 1986. Mushroom collecting and mycorrhizae. Pages 149-153 in Proc. Ninth Annual Trees of Nebraska Conf., Feb. 14-15, Lincoln, Nebr.

Riffle, J.W., and Peterson, G.W., (Tech. Coords). 1986. Diseases of trees in the Great Plains. USDA For. Serv., Rocky Mountain For. and Range Exp. Sta., Gen. Tech. Rep. RM-125. 149 pp.

Riffle, J.W., and Peterson, G.W. 1986. Thyronectria canker of honeylocust: influence of temperature and wound age on disease development. Phytopathology 76: 313-316.

Sillick, J.M., and Jacobi, W.R. 1986. Healthy roots and healthy trees. Colo. State University, Service in Action Bulletin No. 2.926.

Williams, R.E., Shaw, C.G. III, Wargo, P.M., and Sites, W.H. 1986. Armillaria root disease. USDA For. Serv., For. Insect and Disease Leaflet 78. 8 pp.